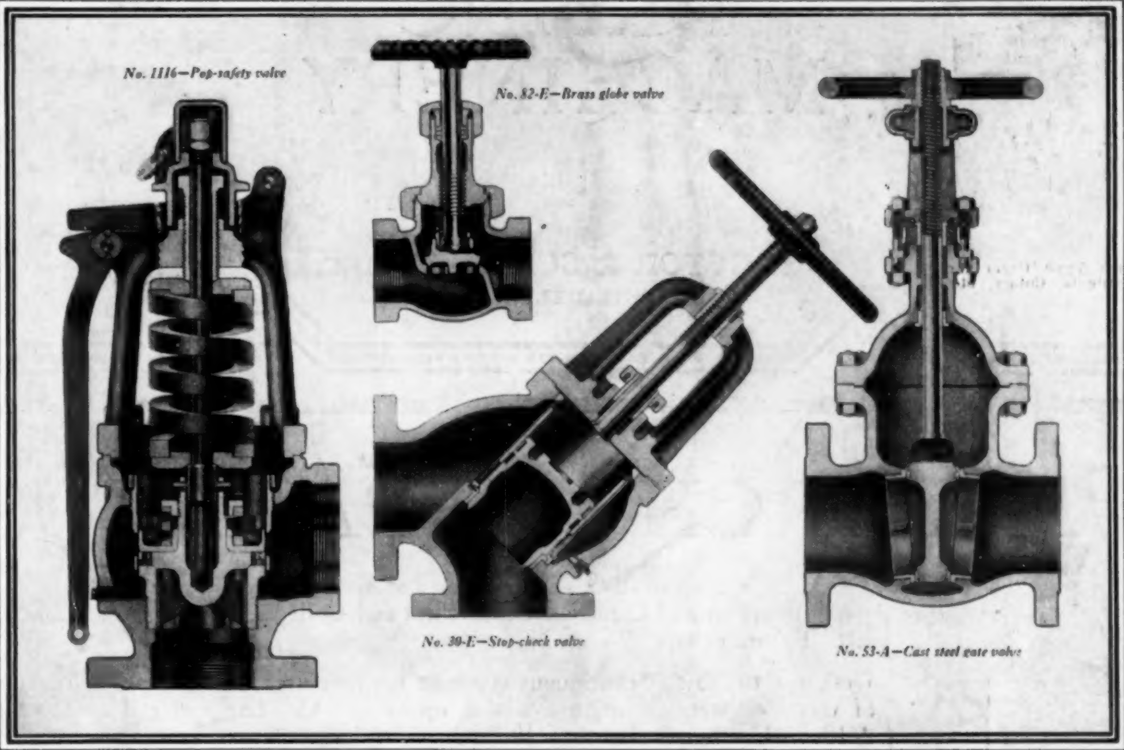
CHEMICAL
& METALLURGICAL
ENGINEERING

McGraw-Hill Co. Inc. November 3, 1924 25 cents per copy



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CHEMICAL & METALLURGICAL ENGINEERING

H. C. Parmelee
Editor

Volume 31 New York, November 3, 1924 Number 18

The Research Worker and The Non-Technical Executive

SPONTANEOUS tribute to our editorial attitude is always interesting, often indicative of an influence that we ourselves seldom realize. A chemist of wide experience recently remarked that a short editorial paragraph had served to change his professional position to such an extent that dissatisfaction and a sense of injustice had been superseded by a feeling of security and contentment. We inclined the editorial ear. Our informant related an experience with his non-technical executive—a common one among scientific workers: Brusqueness and lack of encouragement; restricted facilities; impatience as to results and hints of a rupture of relations. Then came a pointed editorial in *Chem. & Met.* that "hit the mark." The issue, open at the page, was placed on the executive's desk. An interview followed. "I didn't understand," stammered the "superior" officer; but from then on there was no cause for complaint. It was merely an instance of misunderstanding, fostered by the reticence and pride of the chemist. A third party was needed to bring the two together, and a copy of *Chem. & Met.* effectively acted as mediator.

More recently the question of research and its importance to industry was brought to our attention in a very different manner. A consultant to a large enterprise on the chemical borderline, the directors of which have scarcely realized the value of the chemist as a factor in improving the product, in lowering costs and in preventing waste, remarked that the non-technical executive when faced with the need for retrenchment invariably economized first by curtailing or discontinuing the work of the research department. "There's a fine theme for an editorial," he said. We protested, explaining that the subject formed a perennial text with us. *Chem. & Met.* was not being read—that much was evident. We waited for an explanation. "You see," he said, "when I took up this special work I dropped my subscription. No; there's no other real technical paper that covers the field, but *Chem. & Met.* does not specialize in my work."

Chemical engineering is insinuating itself into so many new industries that it is difficult for us to keep abreast of developments unless the pioneer chemist "does his bit" and comes back to us with constructive and informative comment. We claim a large share in having influenced industry to employ him and retain him; we protest with good effect when his interests are imperiled in any manner, when his work suffers from indifference or malpractice. We are prepared to follow him into any legitimate line of endeavor, but we cannot do so if the "painter" is deliberately cut. It is not an easy matter to cater satisfactorily to all our readers; but by careful selection, brevity and the avoidance of the non-essential, we are able to provide an increasing variety of subjects for the consideration of those who realize that the "parish" of the chemical engineer is the world of technical industry.

A Great Misfortune

THE death-dealing plague that settled last week over the tetra-ethyl lead plant at Bayway, New Jersey, was most unfortunate. Serious injury and the loss of human life must always be deplored—never condoned. Even though every precaution that seemed humanly possible were taken, there must always be the feeling that such fatalities cannot be excused. Some comfort, but certainly not justification, is found in the fact that the work was pushing forward along untrodden paths toward a goal that promised a significant advance of technology. Much that civilization owes to science has come about through similar sacrifices. Not one but many of the processes that give us the comforts and necessities of life were first tried out under circumstances fraught with danger, and their problems were not always solved without the loss of life and limb.

But quite apart from humane considerations is the damage that has been done by the quack and the blackmailer. Quick to take advantage of the unfortunate way in which tetra-ethyl lead has now been brought to the attention of the public, these impostors have blatantly condemned its use in motor fuel—a question in no way involved in the New Jersey occurrence. Admittedly the product itself is a poison, but there is nothing to show that its use definitely increases the existing hazard of the automobile exhaust. On the contrary, it is reported that reputable agencies have shown that by increasing the efficiency of combustion it may even reduce the production of carbon monoxide while the lead itself is being deposited in an insoluble form that is not easily carried into the atmosphere by the exhausted gases. Furthermore, the proportion of the compound in the treated fuel is not 5 per cent, as some guardian of the public health would have us believe. Actually it is less than one-tenth of 1 per cent, since but 3 c.c. of the ethyl liquid is added to 3,700 c.c. of the fuel. To correct such misrepresentation and to regain the public's confidence and support will take years of patient teaching by the petroleum industry.

We extend our sympathy to the company, to its injured workmen and to the relatives of those who have been stricken. We lend our support to those public and private agencies that are endeavoring to determine the cause and responsibility for the occurrence. But to those who for personal gain would stoop to capitalize on this great misfortune, we have nothing but contempt and condemnation.

Industrial Co-operation A Factor in Plant Location

THE days of the barbed-wire fence—intellectually as well as materially—between adjoining industries is disappearing, and executives are realizing that the union of the dissimilar often makes for efficiency. Hence the need on the part of the technician for a broad and sympathetic outlook in all phases of the application of science to industry, in addition to specialization in one or more specific branches of our profession. Many an enterprise has been made profitable in consequence of the abandonment of a policy of isolation. The economical evaporation of brine is often dependent on the availability of large quantities of exhaust steam, which suggests an arrangement with a near-by plant consuming a considerable amount of power. Examples of such industrial interdependence are seen in Michigan, where co-operation between a lumber mill and a salt-grainer plant is beneficial to both; in Ohio, where brine is evaporated with exhaust steam from a near-by cardboard factory and a chemical plant, and in California, where the waste heat from a charcoal factory is sufficient to operate an adjoining cannery. Hundreds of similar illustrations could be cited, but there is need to keep the fundamental idea in the foreground, especially when considering industrial success as a whole, which is the more logical attitude.

These considerations suggest a factor in plant location that is seldom taken into account: the possibility of efficient industrial co-operation between neighbors, where costs may be reduced by the avoidance of waste; and we venture to suggest that by far the majority of industrial concerns would profit by the advice of a chemical engineer in the initial stages of planning, as well as after the plant site had been selected.

Scientific Research as a Basis for Commercial Initiative

A FEW months ago we published an editorial on "Electrochemistry and the Manufacture of Gold Leaf," which was prompted by the granting of an English patent for a complete process, whereby the metal was deposited on a ribbon of silver from aurocyanide solution, and intricate provision was made for the chemical dissolution of the silver and the mechanical handling of the gold foil produced.

A courteous letter from Alex. E. Outerbridge, Jr., which we publish on another page of this issue, reminds us of our remissness in not drawing attention to the pioneer scientific work that served as a foundation for the development to which we drew attention, especially because, not long after our editorial appeared, one of the popular writers on the staff of the *Saturday Evening Post* retold to a larger audience the story of gold leaf and the possible displacement of existing hand-beating methods of manufacture by the application of mechanical ingenuity and the utilization of well-known electrochemical principles.

The privilege of inspecting samples of gold leaf made by Mr. Outerbridge in 1877—by electroplating one side of a piece of burnished copper foil and then dissolving the copper in perchloride of iron—brings a realization of the work done in this field nearly 50 years ago for the scientific study of extremely thin metal films, as the inventor remarks, rather than for the development of a commercial process. The patent, granted to Mr. Outerbridge in 1877, covered "The process of obtaining gold leaf, silver leaf and other metallic leaf by electrodeposition of a film of metal upon a suitable vehicle, and the subsequent removal of such vehicle by heat, solvent or other similar means which do not injure the film."

This indicates a broad basis of scientific priority, although the inventor mentions in the specification a preference for the use of copper in thin sheets, metal fusible at a low temperature, shellac, wax or paper as a deposition base, whereas the process we discussed refers specifically to the deposition of gold on silver. Moreover the Outerbridge process was essentially intermittent; the newer one is continuous. However, as we said before, the credit for the basic idea should go to Mr. Outerbridge for his work in the late '70s, when he was assistant in the assay department of the United States Mint at Philadelphia.

The field of science and applied technology is widening so rapidly that the overlapping of research is as inevitable as is its unconscious repetition, with the result that credit occasionally goes astray. J. W. Swan appears to have described, as a new discovery, the Outerbridge method at a meeting of the Royal Society in 1894. The classic example of the simultaneous researches of Darwin and Wallace will be recalled, with their interesting sequel of friendly concession and loyalty to the scientific ideals of truth and fairness. The incident under review forms an argument in favor of the frank publication of results. Even an application for patent, apart from the commercial considerations involved, provides valuable evidence of priority.

Lumber Waste and the Technologist's Opportunity

FRUGALITY is sometimes considered as the unenviable prerogative of the "submerged tenth," although economic considerations are forcing attention to the need for conservation and economy. A recent account of a new Pacific Northwest lumber mill includes the boastful item that the plant is equipped with the largest waste-wood burner in the world! It measures 100x120 ft. Thus is good fuel, or the raw material needed for so many essential products, being disposed of, rather than utilized to industrial advantage.

An unhesitating acceptance of existing conditions is largely responsible for apathy, although a change in attitude is to be noted. The interdependence of technical operations is being recognized as a factor in community and national success; on the whole, nonproductive destruction is being reduced and manufacturing costs lowered. There need be no waste from such a mill if its scheme of operations is planned by an engineer whose perspective goes beyond the production of merchantable lumber as the only outlet for forest products.

Co-ordination of industrial activity is a necessary preliminary to efficient mass production in any community. Isolated and specialized activity in one industrial channel is sometimes unavoidable; but experience shows that opportunity usually exists for a broader conception of the potential worth of the raw materials of which this country is the lucky possessor. As an example of an attitude of judicious and frugal planning, we commend to those interested the tentative

program mapped out by Henry Ford for the utilization of his coal resources in the South, as an alternative to the exploitation of the Muscle Shoals property. If nothing comes of the plans recently outlined in *Collier's*, which is unthinkable, he will have failed magnificently.

Keeping the Primary Objective in View

IN THE discussion of one of the papers presented at the British Iron and Steel Institute last spring there was brought out a word of warning that may well be more widely applied.

In commenting on the paper, a most valuable study of waste heat recovery in open-hearth steel manufacture, Dr. Walter Rosenhain among others called attention to the fact that care should be taken that the steel should not be regarded as a byproduct in the zealous endeavor to save or produce heat. He did not suggest that the author had lost sight of the fact that steel was the primary product, but he feared that a mere mathematical calculation of where the heat went was apt to lead to a saving of heat at the expense of the steel.

There is no doubt that it is easy to lose sight of the principal product when one is looking too closely at a byproduct, especially if that byproduct is a herd of elusive B.t.u. We can imagine a number of cases where such words of warning as those of Dr. Rosenhain might help the diligent industrial cost cutter to maintain his mental balance and to keep his eye on the ball.

Analytical Inference As a Basis for Fiction

THE reappearance of "Sherlock Holmes," in *Collier's*, draws popular attention in semi-serious fashion to the superiority of scientific deduction over rule-of-thumb methods in the solution of human problems and the elucidation of mysteries. Dr. Conan Doyle is a scientist, and therefore finds occasional inspiration in chemical reactions; but we believe that there is opportunity for a more extensive utilization in fiction of common knowledge of a chemical nature. Further effort in this direction will, incidentally, draw more attention than heretofore to the chemist as an important factor in human affairs, as possessed of more than the average amount of fundamental knowledge, keenness of perception and deductive wit. Dr. Conan Doyle has proved that fiction containing none of the so-called "love" element may be written in a manner to interest and amuse, even to educate. Not that we advocate the exclusion of the fair sex from fiction as a general principle; but it is evident that a growing section of the reading public would welcome an occasional alternative to the elaboration of the sex theme that dominates the majority of the modern magazines. Taken by and large, few chemists have ventured outside the field of technical and scientific journalism in so far as publication is concerned, in spite of the fascination of their work and the opportunities for interpreting it, in popular vein, to the average reader.

By far the majority of magazine stories and other fictional efforts are based on actual happenings. The writer who uses chemists and their investigative skill as the mainspring of inspiration will find many suggestions in the results of ordinary routine laboratory work. To quote as an example a recent happening, as recorded in the daily press: The freight claim agent of the Southern Pacific Co. was faced with the task of arranging an adjustment in regard to the theft of a shipment of gloves, made to a San Francisco firm from Neuhaldenslaben, Germany. On opening the package it was found to be filled with a few lumps of coal packed in straw. To the ordinary citizen, coal may be good or bad, but it is merely coal. The problem was to deduce at what point the gloves had been pilfered and the valueless material substituted. The contents of the package were handed over to the analytical department of the railroad company called upon to make an adjustment. The chemist in charge made the necessary examination and reported that the coal came from the Ruhr district of Germany. The evidence pointed to the probability that the theft had occurred in that country. Action was taken with this assumption as a basis, and the gloves were eventually recovered by the German police.

Thanks to scientific educators, the public is being brought to realize the connection between chemistry and industry. The opportunity exists to interest an even wider audience in the connection between chemistry and human nature, for which purpose fiction based on fact is an available channel.

Pioneering And Engineering

THEY tell a story in Colorado of an old prospector who tramped the oil-shale country in the early '80s and liked it so well that he decided to settle there. He built a substantial log cabin and to make it more attractive put in a large stone fireplace made of massive black rock which was easily broken from the side of a near-by cliff. The day he completed the chimney he happened to kill a deer, so he decided to call in the countryside for a house warming. To prepare for the feast he collected some dry wood and started to build a fire in his great new fireplace. But the fire was scarcely under way before fireplace, chimney and all burst into flames and the cabin was soon burned to the ground.

What the prospector thus learned about oil shale probably stood him in good stead on some later day when fuel was scarce; but this knowledge, like the ancient Chinaman's roasted pig, was acquired at a terrific cost.

The difference between pioneering and engineering is largely a matter of knowledge—of facts and properties and uses of material and energy. In any field the first effort is likely to be crude experimentation unless there is experience and closely related knowledge on which to draw for support and guidance. The development of our oil-shale resources is a case in point. The principal reason this development has not been able to proceed as rapidly as some had hoped is the lack of fundamental knowledge of the properties and behavior of oil shale as these bear upon the problems of mining, retorting and refining.

In this issue we publish the third article of the series on oil shale. It reviews the technical problems that confront the industrial worker in this field. More important, it points to the need for ascertaining the detailed data that will broaden our fundamental knowledge of oil shale and at the same time pave the way for scientific pioneering.

Oil-Shale Technology in the Making

Attractive Opportunities for the Application of Science and Engineering Are to Be Found in the Technical Problems of Mining, Crushing and Retorting Shale and in Refining Its Products

By Sidney D. Kirkpatrick
Assistant Editor, *Chem. & Met.*

OIL-SHALE development is, to borrow an expression from Dr. Little, a polygonal problem. It has as many sides and as many angles as the viewpoints of the many specialists who have given it attention. Thus the mining engineer holds, and there is justification for his view, that mining is to play the most important rôle in the new industry. To the chemical engineer the crux of the problem lies in successfully retorting the shale to yield shale oil on a continuous commercial basis. The petroleum technologist is primarily interested in refining shale oil to yield marketable distillates capable of supplementing, or replacing when the time comes, our present petroleum products. And so it goes. Fundamental to all of these views is the economic problem of producing a necessary commodity at a price acceptable to the consumer and profitable to the producer.

Fig. 1—A Sloping Hillside in the DeBeque, Colo., District, Where Conditions Seem to Favor Mining Oil Shale by Open-Cut Methods

The richest part of the thick series of oil-shale strata shown here is the so-called "mahogany" bed, which at this point outcrops in a 50-ft. zone that will average 35 gal. of oil per ton. A cut of 150 ft. depth will yield more than two million tons of oil shale per mile of outcrop.

While all of the technical problems of oil shale are not of equal interest to *Chem. & Met.'s* readers, it seems worth while to consider some of these problems at greater length than was possible in the preceding articles of this series. (See *Chem. & Met.*, vol. 31, pp. 610-15 and 651-5, Oct. 20 and 27, 1924.)

It has been shown that in Scotland—the principal country in which oil shale has been exploited on a large commercial scale—mining accounts for 53 per cent of the total cost of producing refined shale products. Exactly the same conditions will not obtain in this country, but the figure is at least a significant index of the importance of the mining problem.

Many commentators have been inclined to dismiss the subject of oil-shale mining with a brief statement that it will not differ greatly from coal mining and that comparable labor requirements and other conditions may be expected. There are many reasons why this analogy is not an accurate one for all American oil-shale deposits. This is particularly so in the case of the deposits of the Eastern and Middle Western states, and to a lesser extent with the great deposits of the Green River formation in Colorado, Utah and Wyoming. In the first place the beds of workable oil shale of the latter district, instead of being 4 or 6 ft. deep, as is the average coal seam, are 35 to 50 ft. in depth. Instead of dipping at steep angles, the shale beds lie in practically a horizontal plane. Instead of mining many hundreds of feet below the surface, the shale outcrops are usually high above the plant sites. The drainage problem with its heavy requirement of labor and equipment is not a menace in shale mining. Development costs per ton will be lower for shale because of the vastly greater tonnage recoverable per acre of land through the same length of permanent openings. The thick shale beds will be worked with much less difficulty because there will be ample room to use mechanical loading equipment to the best advantage; and the shale can be blasted on a larger scale. It will be observed that practically all of these differences are in favor of shale, implying, therefore, that eventually costs will be less than in the case of coal.

Among the less favorable aspects is the fact that oil shale is not as easily drilled as is coal. This is due to its tough, rubbery nature that makes drilling a slower process and causes more wear on auger bits. The latter difficulty may be eliminated to a large extent by modifying the design of the bit. In much of the development work in this country hand drills have been

most used, although experience in the Catlin mine at Elko, Nev., has shown that electric auger drills are practical. The Cushman mechanically rotated auger drill developed by the Mount Logan Co., at De Beque, has also attracted favorable attention.

Proposed Mining Methods

It is an accepted prediction that most of the shales of the Western deposits will be mined by underground methods. Returning to the coal analogy again, the methods that suggest themselves are the pillar-and-chamber system and the long-wall system. In the former the pillars, which are 10 ft. or more in diameter and 30 to 40 ft. apart, are left standing while the shale from the chambers is removed. Timbers may then be substituted for the pillars or in some instances the latter are removed and the roof allowed to cave.

Many mining engineers hold that the breast-and-bench method used in metal mining, particularly in the zinc and lead mines of Missouri, has advantages over coal-mining methods when applied to the much thicker shale beds. Operation is much the same as by the pillar-and-chamber method except that the pillars are left standing. Breast holes are drilled in the upper parts of the bed and when this is broken away the lower part is removed by means of vertical drill holes. In the zinc mines of southwest Missouri the output is about 8 tons of ore per man-shift underground. The output

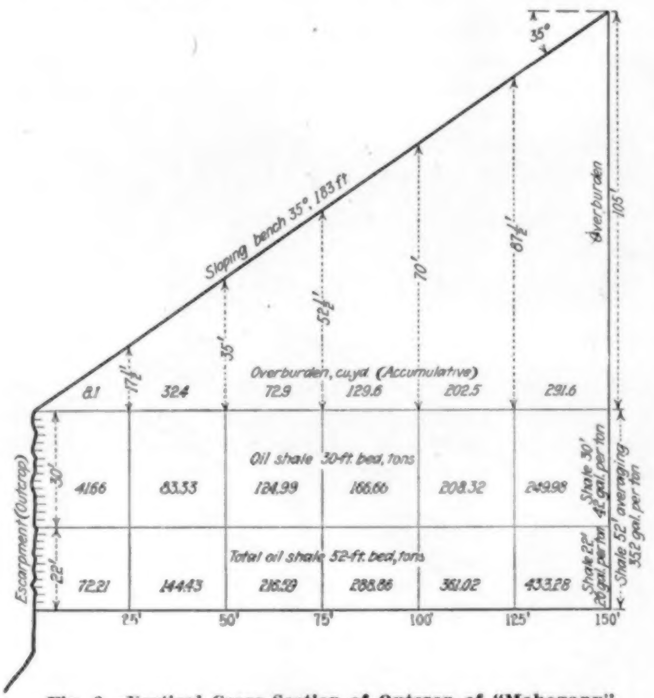

Fig. 2—Vertical Cross-Section of Outcrop of "Mahogany" Bed of Oil Shale

This diagram illustrates the possibility of mining the outcrop of oil-shale beds by open-cut methods on a sloping hillside. The figures of volume of overburden and tonnage of oil shale represent the quantities per linear foot of outcrop for various depths of cut. The shale tonnage is calculated on the basis of 18 cu.ft. per ton.

per miner (which includes helpers) was but $4\frac{1}{2}$ tons in the Scottish shale mines in 1919. (Bureau of Mines Bulletin 210, p. 59.)

In a comparatively few instances it will be possible to employ open-cut or quarrying methods, at least during the earlier stages of the industry. Where these are applicable they are advantageous because of considerably lower costs. W. O. Pray, a mining engineer of broad experience, has shown the writer certain deposits on sloping hillsides in the vicinity of De Beque, Colo., where the overburden above the rich "mahogany" bed of oil shale is comparatively slight and topographical conditions would seem to favor open-cut mining. One such deposit is shown in Fig. 1 and for this particular situation Mr. Pray has calculated the relation of overburden to workable shale and prepared a model illustrating his proposed mining methods (see Figs. 2 and 3). Assuming 30 cents per cubic yard as the cost of stripping off the overburden, and 25 cents per ton for the quarrying of the shale, Mr. Pray's estimates show total mining costs for the 52-ft. bed varying from 28.36 cents per ton for a 25-ft. cut to 45.19 cents per ton for a cut of 150-ft. depth. These figures are based on the mining of 1,000 tons a day using churn drill blasting and electric-shovel loading.

I appreciate the fact that the foregoing discussion of mining is an entirely inadequate treatment of this important subject, but perhaps it will serve to show chemical engineering readers how some of the mining profession are looking forward to the problems of the future industry. While as yet there is little in the way of actual mining operations[1] on which to base experience, we may confidently expect that when the time comes for oil-shale development the mining engineer will be more than able to carry his share of the burden.

The Crushing Problem Varies

The crushing and grinding of oil shale is not a formidable problem, yet it is a variable one, for there is no uniform crushing requirement among the different retorting processes. Some require material ground to 80 mesh; others can handle the shale up to 4 or 5 in. in diameter—or almost run-of-mine ore. Naturally, therefore, we must confine our attention to general rather than specific phases of the crushing problem.

Because oil shale, and particularly the rich massive variety, has a tough and springy structure, it is disintegrated with much more difficulty than is the case with a friable material such as coal. There is a tendency for some of the richer shales to become pasty due to the heat developed in the crushing operation, and this has the effect of making them even more refractory to treatment. Jaw crushers that give excellent reduction of metallic ores have been found unsatisfactory for certain shales due to the sticky, elastic nature of the shale and the tendency to form slabs that "ride" in the crusher.

Retorting processes such as those employed in Scotland require only a preliminary breaking of the shale and for this purpose simple horizontal, toothed rolls are entirely satisfactory. Few American retorting processes can use such coarse material, however, and other methods of crushing will be required. Some engineers plan to use primary and secondary crushing, although single-stage crushing is preferred by the majority. The principal types of equipment adapted to oil shale include, in addition to jaw crushers, gyratories; plain, corrugated or spiked rolls; hammer mill and ring pulverizers; and ball and rod mills for finer grinding.

The location and layout of the crushing plant in relation to the mine and retorts are important considera-

[1]Possible exception is found in the case of the Catlin mine at Elko, Nev., although conditions there are admittedly different than in most of the oil-shale deposits in this country. Superintendent W. L. Sheeler has recently summarized the mining experience at Elko in a brief statement in *The Mountain States Mineral Age*, September, 1924, p. 18.

tions. In most of the experimental plants in this country crushing is done in the vicinity of the retort, in order to utilize power available there and to avoid further handling of the crushed shale. The run-of-mine ore is conveyed to the crushing plant by aërial or inclined trams, and is dumped into bins above the crushers. These discharge into secondary bins, from which the crushed shale is fed by gravity to the retort or elevated to it by belt-and-bucket conveyors. A novel scheme which has apparently worked satisfactorily on present small-scale operation is seen at the Monarch plant at De Beque. Here crushing to ¼ in. is done in a gyratory crusher located at the mine entry, perhaps a thousand feet above the retorting plant. The crushed shale is then dropped down through a 5-in. iron pipe to a receiving bin directly above the retort.

Distillation of Shale

Of prime interest to the chemical engineer is the retorting of the oil shale and refining of its products. It is this phase of the development that offers greatest opportunity for the application of science and sound engineering practice. Of the two problems, however, retorting has received more attention in this country than refining, for, unlike mining, crushing or refining, there is no closely analogous industry on which to draw for experience and knowledge. To be sure, coal carbonization presents somewhat parallel operations, but essential physical differences between coal and shale call for radically different treatment. In passing it is interesting to observe that the byproduct oven of today is said to have had its inception in the Scottish oil-shale industry.

In theory the production of oil from oil shale is a simple procedure requiring merely the controlled application of heat as in any process of destructive distillation. In practice, however, commercial retorting of oil shale presents genuine difficulties of an engineering character largely because of the scale of operations and the handling of material and products of variable properties and behavior. During the past 10 years a hundred or more retorting processes have been proposed, perhaps two dozen experimental plants have been erected in the United States and operated intermittently, and one plant is today approaching a commercial basis. This is sufficient evidence that the problems of retorting have had attention and real progress has been made toward their solution. It is an unfortunate commentary, however, that many of those who have participated in this pioneer effort have had neither the technical training nor the experience that would have made progress more certain and perhaps more rapid. In further articles of this series an attempt will be made to classify the better known of the proposed American retorting processes, and in addition a number of experimental plants which the writer has had the privilege of inspecting will be described.

In the meantime it is perhaps worth while to consider certain factors that affect retorting and that have led to a number of basic principles generally accepted by oil-shale investigators. These factors may be conveniently divided between those that have to do principally with the design and construction of the retorting equipment and those that have a determining influence on the quantity and quality of the product obtained. In the former group we may include:

1. Capacity and continuity of operation.
2. Durability of construction.
3. Method of heat application.
4. Mechanical features.

The chief factors affecting the character of product are:

1. Rate and control of heat application.
2. Heat distribution.
3. Size of retorted shale.
4. Removal of vapors from retort.
5. Cracking.
6. Use of steam.

There are many other factors, such for example as conservation of the heat from the spent shale and vapors and the utilization of incondensable gases, that have an important bearing on economy and efficiency of operation. These will be discussed, later, however, in connection with the individual processes.

Factors Affecting Retort Design

Capacity.—The Scottish retorts are characterized by a comparatively small capacity and slow retorting—the Pumpherston unit holding but 4½ tons and requiring 24 hours for one throughput. There is a general feeling in this country that because of the necessity for large-scale operations and consequent low costs, the maximum capacity of the individual retorting unit is desirable. A retorting plant might be made up of a great many small units, of course, but this generally means greater equipment, labor and operating costs. Most American retorts are planned to treat from 50 tons to several hundred tons per unit per day.

Continuous Operation.—The advantage of continuous operation in heat economy, uniformity of product, ease of maintenance and control are too evident to require elaboration.

Rugged Construction.—One thing that experience has demonstrated is the necessity for strong and durable

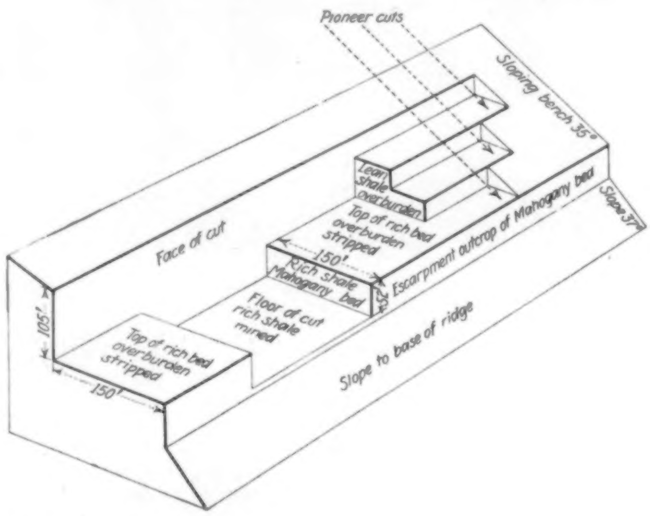

Fig. 3—A Model Illustrating the General Method of Stripping Overburden on Sloping Benches and Mining the Underlying Oil Shale by Open-Cut Methods

This model applies particularly to conditions shown in Fig. 1, in which the oil shale outcrops in a vertical escarpment beneath a smooth sloping bench free of soil or rock débris. By stripping a triangular section of the lean shale that overlies the rich mahogany zone, the latter can be mined for a distance of about 150 ft. back of the outcrop. At the left end of the model the shale is shown stripped of overburden and ready for mining. To the right of this a cut has been started in the rich shale and mining can proceed in two directions at right angles to the line of outcrop. At the right end of the model a part of the overburden is in the process of being stripped off as the pioneer cuts are being advanced. It is planned that blasting in these cuts will be so conducted that the greater part of the material will be thrown clear of the workings to roll down the slope and be wasted over the escarpment. About 20 per cent of the overburden can be removed in this way. The remainder will be broken by heavy blasts, picked up by electric shovels and wasted directly in front of the excavation.

construction. More than one experimental plant has had its difficulties resulting from failure of some part of the retort to stand up under the strain of operating conditions. Repairs mean costly shut-downs and loss of production. The choice of the proper material of construction to withstand the heat, the action of the hot shale and vapors is often a serious problem.

Heat Application.—The method of applying the heat to the shale is basic to the design of the retort. The shale may be heated externally as in a coal retort, or it may be heated from within by superheated steam, by some inert gas or by the products of the combustion of the shale itself. Oil shale is an effective insulating material, and it is a real problem to provide means of applying heat uniformly throughout the charge of the retort. Unless the shale is heated in relatively thin layers or special provision is made for moving the material through the heat zone, external heating is unsatisfactory. There will be excessive cracking of the oil distilled from the hottest shale, while that farthest from the source of heat may yield but a fraction of its total oil. If external heating is used, efficient construction of the retort furnace is necessary not only to make best use of the fuel but also to provide temperature control and to recover as much as possible of the heat leaving the retort with the spent shale and the oil vapors.

Mechanical Features.—Experience has demonstrated that retorts to meet American conditions will have to be of the simplest construction that will permit large-scale continuous production with the minimum of operating attention. Moving parts in the heat zone must be reduced to a minimum or entirely eliminated. While iron and steel will normally withstand the moderately high retorting temperatures, conditions in the retort due to coking of the shale may often put unusual strains on the storing or agitating equipment. If the latter fails, its replacement means delay and interrupted production. Of course, additional power is required for these devices.

The use of automatic machinery for charging and discharging the shale and for other purposes is warranted provided it does not complicate rather than simplify operation.

Factors Affecting Product

It may be said that the sole objective of an oil-shale industry is to produce at lowest cost the largest possible quantity of crude shale oil capable of being refined into marketable products of high quality. Therefore the retorting factors that affect the yield and character of the product are basic to the entire development and warrant closest attention and study.

Rate and Control of Heating.—In our desire to boost output by increased capacity and more rapid distillation, we cannot afford to lose sight of the fact that the shale oil is produced by the chemical reaction that requires time as well as careful temperature control. The research of the Bureau of Mines, confirmed by broad experience of other investigators, has proved conclusively that temperature, pressure and time absolutely determine the character of the product. It has been shown that this is not the result of a fractional eduction whereby the more volatile products are distilled from the shale at low temperatures and the less volatile at high temperatures. Rather it is better explained by the cracking phenomenon, for as the bituminous material is first formed from the kerogen over a very narrow temperature range, it is broken down immediately into the hydrocarbons that make up the various distillates. The earlier retorts designed to take off vapors at various stages of the retorting process in accordance with the fractional-education theory succeeded to a slight extent only because the cracked vapors were fractionally condensed in the different parts of the retorts.

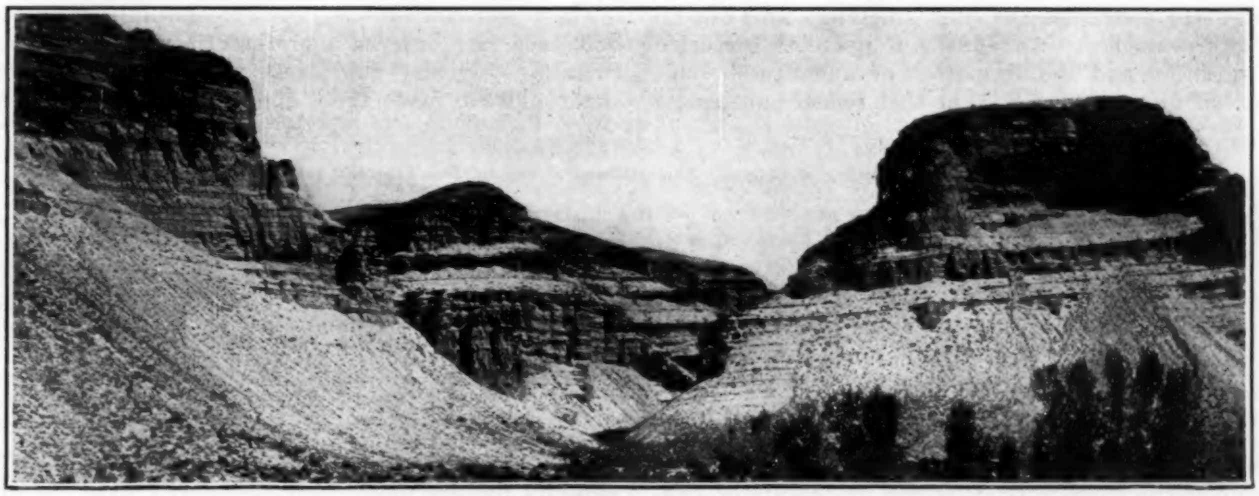

Fig. 4—An Oil Shale Deposit in Uintah Basin, Utah

Heat Distribution.—What has just been said about the control of the heat applies to the way in which it is distributed throughout the shale. In order to obtain a uniform product it is desirable that every portion—indeed, every particle of the shale—be heated to the same temperature and under the same conditions. This can only be approximated in practice, but it is more nearly realized when the shale is retorted in thin layers or (if the heat is applied within the retort) when finely crushed or otherwise intimately exposed to the steam, gas or other heating medium.

Size of Material.—The extent to which crushing should be carried is a moot question. The answer is likely to be a compromise between the advantages of rapid and uniform heat penetration and the added cost of finely grinding such a refractory material as oil shale. It was previously pointed out that the Scottish industry merely breaks the shale through crushing rolls and to this extent the practice at Elko, Nev., is quite comparable. With fine grinding, and especially in

mechanically stirred retorts, shale dust is a serious problem. It accumulates in the vapor and condenser line, contaminates the oil with mineral matter and its removal is an additional but necessary operation.

Cracking and Vapor Removal.—The nature of the cracking process by which the vapors are formed from the oil-yielding material in the shale makes it obvious that they should be removed as rapidly as possible and be protected from the higher temperatures that would cause excessive production of fixed gas as well as other undesirable decomposition products. From the construction viewpoint it is desirable to provide large and easy outlets for the vapors. In the Scottish retorts the vapors are removed by the use of slight suction. In this retort it is also one of the functions of the superheated steam to carry away the oil vapors as they are formed.

Use of Steam.—There are many other reasons why the use of steam is distinctly advantageous. As the steam enters the retort it comes in contact with the hot spent shale, cools it and in so doing reacts with its carbon and nitrogen to yield water-gas and ammonia. It serves to distribute the heat uniformly and can be carefully controlled. And finally it prevents excessive decomposition and the formation of undesirable compounds of nitrogen and sulphur that render subsequent refining more difficult. The fact remains, however, that in some of the shale districts of the United States sufficient water supply is not available, at least under present conditions, to make the use of steam economical.

Refining Problems

The analogy between petroleum and shale-oil refining holds as to the products desired and to the general procedure to be employed. When we consider composition, however, we find certain essential differences between crude shale oil and crude petroleum. The shale oils contain abnormally high proportions of the unsaturated hydrocarbons—as much as 85 per cent of the crude or 60 per cent of the gasoline fraction of some oils being soluble in 66 deg. sulphuric acid. Another characteristic difference is that crude shale oil contains a considerable percentage of nitrogenous bases of the pyridine and quinoline type. These account largely for the fact that in Scotland shale oils seldom yield more than 75 per cent of refined products,[3] while in a complete petroleum refinery in the United States well over 90 per cent and usually as much as 95 per cent of refined products is obtained.

The presence of a large percentage of unsaturated hydrocarbons (olefines), however, is not an unmixed evil, for while these compounds do make refining more difficult, they yield a gasoline that in some ways is superior to straight paraffine gasoline. It is of higher specific gravity and, weight for weight, will yield 10 to 15 per cent more energy. To remove the troublesome diolefine compounds (that give the gasoline its foul odor and undesirable color) without serious loss of the olefines is the refining problem. That it can be solved by modifying the standard refining methods is shown by the success of the Scottish shale companies and by the large amount of experimental work that has been done on refining in this country.

Many have commented on the fact that the color problem is a serious one in shale-oil refining. The lighter distillates often have a reddish or even purple color that is not removed by the usual acid or alkali treatment. It is quite probable that the coloring matter is in no way deleterious, but as long as a fickle public insists on water-white gasoline, it will have to be served and the color removed. Recent progress in the decolorizing art by the use of acid-treated clays and the new decolorizing carbons suggest that the color problem will not be a serious deterrent to the progress of the oil-shale industry.

The Scottish shale oils yield excellent lubricating oils that have long enjoyed a preferential market in Great Britain. Recently lubricants made from American shale oil have made their appearance in the domestic market and severe road and laboratory tests have apparently demonstrated their superiority over the ordinary lubricants.

The paraffine wax obtained from shale oil has a higher melting point than that obtained from petroleum. In fact, in Scotland the wax and the ammonium sulphate have long been regarded as the mainstays of the oil-shale industry. A very high-grade white wax has been produced from the Nevada shales for several years and has been easily marketed at a fair price in the face of severe competition.

The general character of Colorado shale oils is shown in Table I. The ten distillation records are typical analyses selected from more than 1,500 tests and partial tests in refining made by the Colorado Geological Survey and published by Prof. R. D. George in 1921. In commenting on the character of the refined products from shale oil, this authority makes this significant statement:

> The refined products obtainable from shale crude are: Gasoline, kerosene, light and heavy lubricating oils, paraffine wax, residual tars and cokes. The gasoline and kerosene will be hard to clarify but in matters of use they will equal, if not surpass, those from well petroleum. The lubricating oils are superior to those from well oil. The wax is of superior quality. No satisfactory tests of the uses and value of the residual tars and coke have been made. As to the commercial possibilities of the shale-oil industry there can be no reasonable doubt. But it must be kept in mind that the happy-go-lucky methods of petroleum winning will spell ruin if followed in the shale-oil industry. It is an industry demanding technical skill of a high order.

Table I—Characteristics of Colorado Shale Oils as Shown by Ten Typical Analyses

	1	2	3	4	5	6	7	8	9	10
Gravity of crude, deg. Bé	26.8	27.0	27.0	27.2	26.4	30.7	31.2	26.9	32.2	29.4
Gasoline, per cent	15.4	15.0	15.35	15.3	16.8	18.9	20.4	14.8	21.1	18.2
Gravity of gasoline, deg	51.0	51.0	50.5	50.5	50.8	52.1	53.0	51.1	53.6	51.6
Kerosene, per cent	32.3	32.5	31.0	33.3	30.7	30.0	27.8	35.0	25.6	28.2
Kerosene, gravity, deg	36.0	36.0	35.5	35.0	36.2	37.4	37.6	38.0	37.7	38.0
Gas oil, per cent	23.1	22.5	26.0	20.0	18.4	18.9	14.4	13.0	20.4	19.7
Gas oil, gravity, deg	33.5	34.0	33.0	34.0	33.8	34.1	30.3	30.7	30.6	32.8
Light lubricating, per cent	17.0	17.0	15.5	18.5	17.8	14.6	18.4	17.4	15.9	20.5
Gravity, light lubricating	30.0	30.5	31.0	30.5	31.2	30.4	31.0	31.2	30.2	30.5
Heavy lubricating, per cent	10.0	11.5	9.5	11.7	12.4	14.2	15.4	12.8	10.1	9.9
Gravity, heavy lubricating, deg	24.5	25.0	26.0	25.5	24.7	24.9	26.2	26.0	24.8	24.4
Coke and loss, per cent	2.2	1.5	2.7	1.4	3.9	3.4	3.6	7.0	6.9	3.5

[3]An exhaustive report on the Refining of Shale Oil in Scotland, by Edwin M. Bailey, was published in the *Journal* of the Institution of Petroleum Technologists, July, 1924, pp. 527-59.

Some Observations on Aluminum Paints

Tests Showing How and When Aluminum Paints Can Be Used Most Satisfactorily

By P. H. Walker and E. F. Hickson
United States Bureau of Standards

Bridge Over Grasse River at Massena, N. Y., Painted With Aluminum Paint

DURING November, 1920, the Bureau of Standards exposed on the Chemistry Building roof six metal panels, one half of each panel being painted with aluminum paint and the other half with red lead-linseed oil paint. In this series of tests, 15 per cent and 30 per cent of aluminum powders (by weight of the paint) were mixed with boiled linseed oil and spar varnish, in order to ascertain the durability of such paints on metal, as compared with red lead-linseed oil paint. The paints, made by hand stirring the dry pigments in the liquids, were as follows:

No. 1

Aluminum powder ....3⅓ lb.
Boiled linseed oil ....1 gal.

No. 2

Aluminum powder ....3⅓ lb.
⅔ boiled linseed oil }
⅓ spar varnish } ......1 gal.

No. 3

Aluminum powder ....1⅓ lb.
Spar varnish ....1 gal.

No. 4

Dry red lead..............20 lb.
Raw linseed oil ....5 pt.
Turpentine ....2 gills
Drier ....2 gills

The paints were applied, by brushing, to one side of clean, horizontal steel panels measuring 18x24x¼ in. The left hand half of each panel received the red lead paint, and the right half the designated aluminum paint. The whole of the exposed area of the plate was covered by the first coat, two-thirds only by the second coat and one-third only by the third coat. The first coats were applied on Oct. 26, 1920, the second coats on Oct. 28, and the third coats on Nov. 1. The painted panels, after drying in the laboratory, were exposed on Nov. 5, 1920, on the roof of the Chemistry Building. The panels faced south at an angel of 45 deg., with the area covered by three coats at the top.

The results, after 3½ years of exposure (May, 1924), are shown in Table I. The differences on plates *A*, *B*, *C* and *D* cannot be well shown in small-scale illustrations, but plates *E* and *F* are reproduced in Fig. 1.

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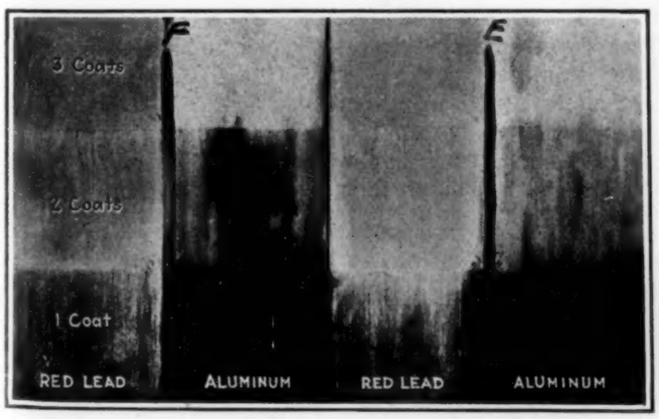


Fig. 1—Comparison of Aluminum and Red Lead Paints
In each of these two panels, *E* and *F*, the paint on the right half is aluminum and on the left half red lead. The dividing line is a stripe of lamp-black paint. The horizontal divisions of the one, two and three coats can be seen, the bottom third of the plates being covered by single coats.

Table I—Results of Exposure Tests on Aluminum and Red Lead Paints

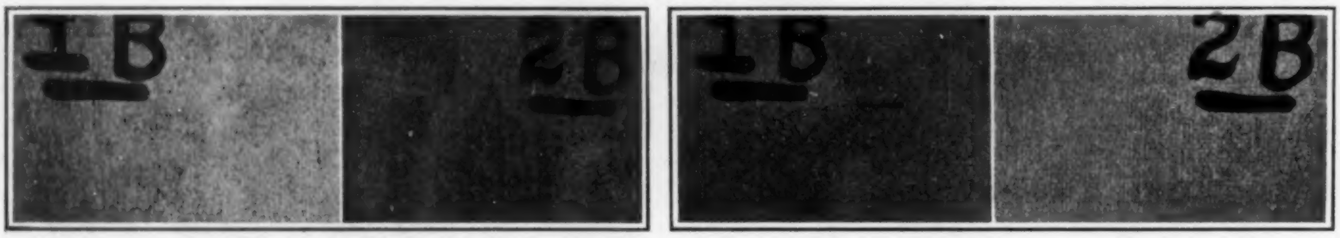
Panel	Painted Surface	Results
A	1 coat —paint No. 1	Practically gone
(aluminum)	2 coats—paint No. 1	Good condition
	3 coats—paint No. 1	Excellent condition
(red lead)	1 coat —paint No. 4	Practically gone
	2 coats—paint No. 4	Faded (nearly white) and chalking, but in good condition
	3 coats—paint No. 4	Faded (nearly white) and chalking, but in excellent condition
B	Same as in panel *A*	Practically duplicate that of panel *A*
C	1 coat —paint No. 2	Practically gone
(aluminum)	2 coats—paint No. 2	Rust streaks showing through; fair condition, needs repainting
	3 coats—paint No. 2	Excellent condition
(red lead)	1 coat —paint No. 4	Practically gone
	2 coats—paint No. 4	Chalking and faded, but in good condition, some rust streaks
	3 coats—paint No. 4	Chalking and faded, but in excellent condition
D	Same as in panel *C*	Practically duplicate that of panel *C*
E	1 coat —paint No. 3	Gone
(aluminum)	2 coats—paint No. 3	Considerable rust; poor condition
	3 coats—paint No. 3	Rust streaks showing; fair condition.
(red lead)	1 coat —paint No. 4	Practically gone, but better than the aluminum
	2 coats—paint No. 4	Chalking and fading, but in good condition
	3 coats—paint No. 4	Chalking and fading, but in excellent condition
	Same as in panel *E*	About the same as in panel *E*; 2 coats of paint No. 3 shows more rust than the same paint in panel *E*.

The conclusions that may be drawn from these exposure tests are:

1. An aluminum paint containing from 25 to 30 per cent of aluminum powder in a vehicle composed of boiled linseed oil, or a mixture of boiled linseed oil and spar varnish, will prove to be a durable outside paint for metal, when applied in three coats.

2. Two coats of these paints will give good service on metal; one coat only is not recommended.

3. An aluminum paint containing 15 per cent of the powder in spar varnish is not nearly the equal, for out-



Figs. 2 and 3—Curious Effect Produced by Reflected Light on the Appearance of Surfaces Painted With Aluminum Paints

These are different views of the same panel *B* in which paint *1B* is the polished standard aluminum paint (No. 5) and paint *2B* is the unpolished standard paint (No. 6). It will be observed that Fig. 2 shows paint *1B* to be the whiter paint, while Fig. 3, taken by a different light, shows paint *2B* to be the whiter. The same effect is noticeable at different times when observing these paints from the ground.

door durability on metal, of one containing about twice as much (25 to 30 per cent) aluminum powder in a mixed vehicle of spar varnish and boiled linseed oil. This will hold for a one, two or three coat job.

4. Aluminum paint containing boiled linseed oil without any spar varnish is somewhat more durable for outside use, under the conditions of our tests, than a paint containing an equal amount of the same aluminum powder but in a vehicle of two-thirds boiled linseed oil and one-third spar varnish.

New Exposure Tests

In November, 1923, six additional metal panels were exposed. In this series all painting was done with the panels in a horizontal position, and two coats were applied in all cases. The purpose of this test was to determine the relative wearing qualities of different kinds of aluminum powder, especially the polished and unpolished grades, in a vehicle of spar varnish and the relative durability of all the aluminum paints as compared with red lead-linseed oil paints.

The four kinds of aluminum powder were furnished by the Aluminum Company of America, and the various grades and formulas used were as follows:

Paint	Materials	
5.	"Polished standard" aluminum powder	2 lb.
	Spar varnish (meeting B. S. Circ. No. 103)	1 gal.
6.	"Unpolished standard" aluminum powder	2 lb.
	Spar varnish	1 gal.
7.	"Extra fine" (polished) aluminum powder	2 lb.
	Spar varnish	1 gal.
8.	"Extra brilliant" (polished) aluminum powder	2 lb.
	Spar varnish	1 gal.
9.	Equal parts by weight of powders 1 and 2	2 lb.
	Spar varnish	1 gal.
10.	Red lead (pure) linseed oil paint, using the same formula described in the first series of exposure tests.	

The first coats of all paints were applied Oct. 13, 1923, the second coats Oct. 23, and were exposed Oct. 25, 1923, facing south at an angle of 45 deg. The paints had good brushing and drying properties, although that made with the unpolished standard aluminum powder was a trifle thick.

These panels have now been exposed for 10 months, and it is too early to note any defects; all are in excellent condition. The unpolished standard aluminum paint shows rain and other stains more readily than do any of the other grades. The red lead paint has lost its oil gloss, and its color has faded somewhat, but otherwise the paint is in excellent condition.

All of the tests shown in Figs. 4, 5 and 6 illustrate the rapid leafing qualities of dry polished aluminum powders when mixed in various paint liquids. It is reasonable to suppose, as pointed out by Edwards ("Aluminum Paint," by Junius D. Edwards, Aluminum Company of America, Pittsburgh, Pa.), that this metallic top layer or coating protects the more easily perishable paint vehicle from the sunlight. We recommend that aluminum paint be mixed on the job in small lots and used the same day, since this desirable leafing quality gradually diminishes in ready-mixed paints. It is also true that mixed aluminum paints kept in closed packages for various lengths of time are likely to produce gases and burst the packages.

Aluminum Paints for Vertical Surfaces

The exposure tests started in 1920 indicated that an aluminum paint having a vehicle composed entirely of boiled linseed oil was more durable on outside exposure than paints containing an equal quantity of aluminum powder in a vehicle composed of two-thirds boiled linseed oil and one-third spar varnish. These tests were, however, made by painting the panels in a horizontal

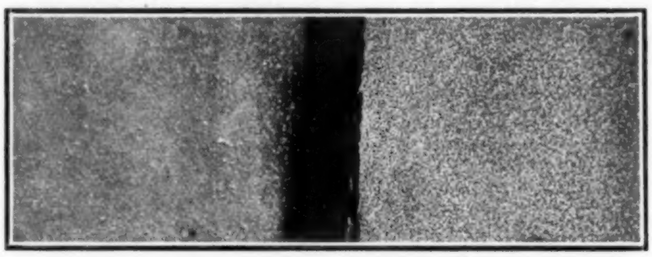


Fig. 4—Comparing Polished and Unpolished Aluminum Powders in Spar Varnish

In the left-hand panel one coat of "polished standard" was applied in spar varnish, while the paint on the right is "unpolished standard" in the spar varnish. The smooth, silvery sheen produced by the polished aluminum is in striking contrast to the lack of sheen in the unpolished aluminum powder. Both of these paints were applied over a blue undercoat, which brings out the excellent hiding power of aluminum paints—one coat completely hiding the blue body color.

position. Subsequent experience indicated that some aluminum paints frequently showed decided tendencies to run and sag when applied to vertical surfaces. Therefore several paints were made using 2 lb. of polished aluminum powder (standard) to 1 gal. of liquid, and applied to clean, smooth, vertical iron plates. The following formulas gave paints of good brushing consistencies that when applied to the vertical plates gave firm, uniform, smooth films free from running, streaking or sagging:

No. 11

Aluminum powder, polished,	2 lb.
60 parts bodied linseed oil*; 6 parts liquid paint drier; 34 parts mineral spirits	1 gal.

*Raw linseed oil heated to 295 deg. C. for 3 hours.

No. 12

Aluminum powder, polished,	2 lb.
Long oil water-resisting spar varnish (B. S. Circ. 103)	1 gal.

No. 13

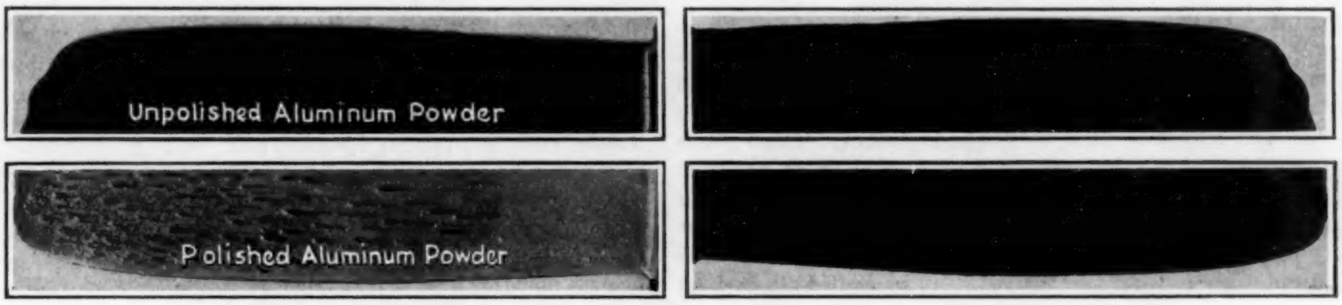
Aluminum powder, polished,	2 lb
"Bronzing liquid"*	1 gal.

*Commercial sample of a brittle rosin varnish not suitable for outdoor use.

No. 14

Aluminum powder, polished,	2 lb.
$\frac{2}{3}$ spar varnish (B. S. Circ. 103); $\frac{1}{3}$ boiled linseed oil (B. S. Circ. 82)	1 gal.

On the other hand, the following formulas were found



Figs. 5 and 6—Two Asphaltum Varnishes Made With Polished and Unpolished Aluminum Powders

Both of these paints were flowed on a glass plate. One of the few ways to make a "white" asphaltum paint is illustrated by the use of the polished aluminum powder, which is shown in the lower section at the left. The reverse side of the plate, at the right, shows the even black asphaltum surface.

to give aluminum paints of a suitable brushing consistency, but unsatisfactory when applied to smooth, vertical iron plates. The photographs (Fig. 7) of these show somewhat imperfectly the results:

No. 15

Aluminum powder, polished	2 lb.
90 parts raw linseed oil, 10 parts liquid paint drier	1 gal.

No. 16

Aluminum powder, polished	2 lb.
80 parts raw linseed oil, 10 parts spar varnish, 10 parts liquid paint drier	1 gal.

No. 17

Aluminum powder, polished	2 lb.
$\frac{2}{3}$ spar varnish, $\frac{1}{3}$ boiled linseed oil	1 gal.

No. 18

Aluminum powder, polished	2 lb.
Boiled linseed oil	1 gal.

For the comparison of the photographs of these streaky paints, there is also shown in Fig. 7 one of the satisfactory paints, that of 12.

Recommended Use of Aluminum Paints

The results of these experiments on streaky aluminum paints indicate that for the painting of vertical surfaces such as bridge members, tanks, etc., the use of raw or boiled linseed oil as the liquid is not advisable. Such paints, especially in the case of the raw oil, do not form continuous films but exhibit marked running, streaking and sagging. An increase in the amount of aluminum powder in these oil vehicles over that used in the above-described experiments seems to lessen to some extent the streaky defect. However, in our experiments increasing the aluminum to as much as 3½ lb. to 1 gal. of boiled linseed oil gave a somewhat streaky paint on vertical metal. This same formula gave a very durable paint on outdoor horizontal surfaces as was shown in the 1920 tests. It is safe, therefore, in the painting of vertical iron surfaces exposed to the weather to use at least 2 lb. of polished aluminum powder in either 1 gal. of long oil water-resisting spar varnish (meeting B. S. Circ. 103), or 1 gal. of a mixture of two-thirds spar varnish and one-third boiled linseed oil (meeting B. S. Circ. 82), or 1 gal. of a mixture of heavy bodied linseed oil (see formula No. 11) thinned with mineral spirits and drier. These three paints are recommended for the outdoor protection of iron and steel, when applied in at least two and preferably three coats; the last two formulas would probably be more durable than the one containing straight spar varnish. One gallon of average long oil water-resisting spar varnish will weigh about 7½ lb., and with 2 lb. of aluminum powder, the paint will weigh about 9½ lb. to the gallon and contain about 21 per cent of pigment by weight.

For extreme durability for outside exposure, as much as 2½ lb. of aluminum powder to the gallon of liquid is recommended, provided the paint, without the addition of much turpentine or mineral spirits is still of good brushing consistency. A gallon of this paint will weigh about 10 lb., and contain about 25 per cent of pigment by weight. For ordinary interior use, 1½ to 2 lb. or more of aluminum powder mixed with either 1 gal. of spar varnish meeting B. S. Circ. 103 or 1 gal. of a mixture of two volumes of spar varnish and one volume of turpentine or mineral spirits will give quick drying, serviceable paints. Two or more pounds of aluminum powder mixed with 1 gal. of equal volumes of spar varnish and turpentine will give a good radiator

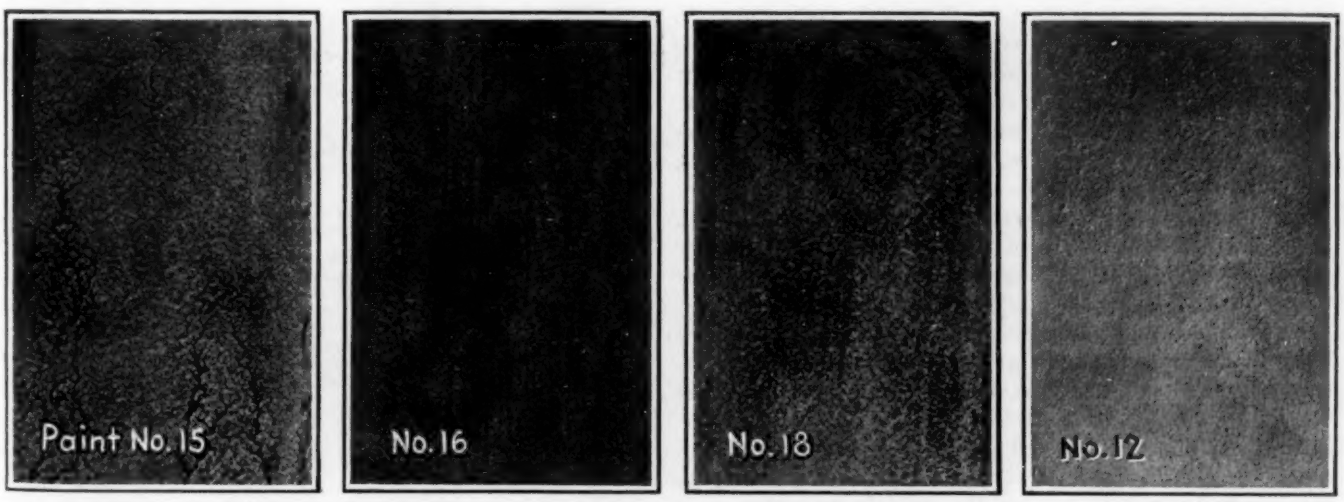


Fig. 7—Three Aluminum Paints (Nos. 15, 16 and 18) That Proved Unsatisfactory When Applied to Smooth, Vertical Iron Plates Are Compared With One (No. 12) That Gave Satisfactory Results

It will be seen that No. 15 showed marked running and sagging. The addition of spar varnish in No. 16 did not materially improve this. No. 18 gave a better paint than 15 or 16, but not so good as No. 17 (not shown), which contained both the spar varnish and the boiled linseed oil. These streaky paints are compared with the satisfactory paint No. 12.

paint. Additional experiments have been made to determine the effect of sulphide fumes on the color of aluminum paints. This is often of importance on oil tanks and other places where the top coat paint is more or less subjected to sulphide fumes. The results indicate that a paint composed of 2 to 2½ lb. of polished aluminum powder in 1 gal. of a long oil water-resisting spar varnish (a commercial sample free of lead, but containing cobalt) shows no discoloration when exposed to sulphide fumes; the substitution of boiled linseed oil (containing 0.12 per cent lead) for the spar varnish in this paint showed appreciable darkening in hydrogen sulphide.

The physical character of other metal powder pigments, such as "copper bronze" and "pale gold bronze," is similar to aluminum powder. These bronze powders are, however, of higher specific gravity, and hence about twice as much pigment must be used to make satisfactory brushing paints as is necessary with aluminum bronze powder.

Bonding High-Temperature Refractories

Results of Practical Study Designed Particularly to Aid the Electric Furnace Operator in Selecting Satisfactory Bonding Materials for Use in Patching, Fettling and Making Monolithic Linings

By R. C. Gosreau
Metallurgical Engineer and Electrometallurgist, Chicago, Ill.

TO THE operators of electric and fuel-fired furnaces, the refractory problem constitutes prime consideration in the maintenance of furnace operations. Refractories suitable for high-temperature work must combine many properties in a harmonious blending to make them adaptable. Fortunately we have many such materials on the market, which in a measure fill the rigid requirements of such furnace operations. Although the ultimate has not been reached in the most advantageous uses of our acid, neutral and basic refractories, yet we have good measure of successful operations. Our refractories at present are utilized in the form of brick, cements and dry grains, and these materials derived from the natural minerals are adapted by suitable fabricating processes to the requirements of the furnace operator.

The purpose of this paper is to deal with the use of grain and powder refractories, not as the brick manufacturer uses them, but as the furnace operator must use them on the job, either as patching, fettling, cements or monolithic lining material. It is well known that to make most refractory substances stick together, some bonding material must be added. High softening point refractories are used, but in order to make them stick, the high softening point must be modified to some extent by so-called "binders." These binders may be solid, liquid or a mixture of both as in an emulsion. When the mixture of refractory and bond is burned, the bond may or may not react with the refractory, but it must fill the rôle of holding the grains of inert refractory together, and giving strength to the mass.

For a number of years electric furnace operators have been utilizing refractory grains and powders to compose the hearths of their furnaces. These mixtures were fused in, similar to the manner in which open-hearth bottoms are burned in, but in the electric furnace the agency of the electric arc and resistance heating has materially facilitated the use of purer materials for bottoms, with less modifying of the original high softening point of the refractory. Using their experience with bottoms, electric furnace operators have at-

Table I—Satisfactory Binders for High-Temperature Refractories

Binder	Physical Condition	Used With Refractory
Acids:		
Hydrochloric acid	8 % sol.	EDB and plastic magnesia.
Sulphuric acid	10% sol.	EDB and plastic magnesia.
Alkalis:		
Caustic soda	26 Bé. sol.	Zircon. Zirconia. EDB magnesia
Lime water	Liquid	EDB and plastic magnesia plus silica.
Salts:		
Aluminum sulphate	1.20 sp.gr. solution	EDB magnesia. Zircon. Zirconia
Borax and borates	Saturated sol	EDB magnesia.
Magnesium chloride	25.5 Bé. solution	EDB and plastic magnesia.
Magnesium sulphate	22-24 Bé. solution	EDB and plastic magnesia.
Sodium chloride	1.12 sp.gr. solution	EDB and plastic magnesia.
Oxides:		
Alumina	40-60 mesh powder	EDB magnesia. Zircon. Zirconia.
Ferric oxide	40-60 mesh powder	EDB magnesia. Silica.
Silica	60 mesh powder	EDB magnesia.
Silicates:		
Sodium silicate	22 Bé. solution	Chromite. Silica. EDB and plastic magnesia.
Calcium silicate	Powder	EDB and plastic magnesia.
Ball clay	40-60 mesh powder	EDB magnesia. Zircon. Zirconia Silica. Chromite.
Floated clay	Emulsion with 5% solids	Silica. EDB magnesia. Zircon. Zirconia.
Serpentine clay	60 mesh powder	EDB magnesia. Chromite. Zircon. Zirconia. Silica.
Mica schist	40-60 mesh powder	EDB magnesia. Silica. Zircon.
Basic slag	40-80 mesh powder	EDB magnesia. Zircon. Zirconia. Silica.
Organic:		
Asphaltum	Hot solid	EDB magnesia.
Boiled tar	Liquid	EDB magnesia.
Slaughter house sludge	Liquid with app. 5% solids.	EDB and plastic magnesia.
Tannery sludge	Liquid with app. 5% solids	EDB magnesia. Zircon. Zirconia. Chromite.
Wood oil	Liquid, hot	EDB and plastic magnesia.
Crude oil	Liquid	EDB and plastic magnesia.
Molasses	Liquid, 1 Molasses, 3 water	EDB magnesia. Zircon. Zirconia. Silica.
Boiled starch	10% sol. hot	EDB and plastic magnesia. Zircon. Zirconia.
Sugar	Saturated sol.	Suitable only when the bond must be of very high purity as in making crucibles. EDB magnesia.
Glycerine	1.02 sp.gr. aqueous sol.	EDB magnesia. Zirconia. Zircon.

Key to Materials Used in Table I

EDB magnesia—Electrically dead-burned magnesia.
Plastic magnesia—Single calcined to drive off all CO_2.
Representative analyses of the materials:

	Insol.	MgO	CaO	FeO	ZrO_2	SiO_2	Fe_2O_3	Ignit. Loss
EDB magnesia...	6.45	91.85	Tr.	.....	.....	.....	1.90	0.30
Plastic magnesia.	3.20	83.25	Tr.	.....	.....	.....	.75	11.35
Basic slag......	....		52.00	10.00	.....	35.00	.....	.....
Iron ore........	....	.....	.....	.....	.....	6.85	92.4	.....
Zirconia (Baddleyite)...	....	.....	.....	.....	87.00	8.00	3.00	.....
Zircon (Wisconsin) (Calculated to ZrO_2. SiO_2, 79%...					52.90	32.95	5.10	.....
Chemically treated Zircon........ ZrO_2. SiO_2, 90.7%.								

tempted to build up their walls of tamped-in materials, thus forming monolithic linings instead of the many unit brick structures generally used for furnace walls. But obviously the walls and roofs could not be constructed in the same manner that a hearth could be constructed, and the operator was forced so to dilute the refractoriness of the material by admixing suitable bonds that much of the refractory nature of the original material was lost when finally finished in the monolith.

There have been developed a great many materials suitable for the bonding of acid, neutral and basic refractories. Each has its specific applications to the material and the temperature of burning and the conditions existing during the time when the material is being burned in its place in the furnace wall or hearth.

The choice of substances desirable and most suitable for such uses is in reality limited. Although there are hundreds of materials, organic and inorganic, that may find application to bond refractories, when a study is made of their uses it is found that most of them are objectionable for some cause or another, and we finally become limited to a few. For high-temperature bonds we find that the silicates, the ferrates and the aluminates in the inorganic bonds are the most suitable. Organic bonds are numerous, but these burn out and do not become a part of the final mass, with the exception where

Table II—Refractory Bonds and Mixtures and Burning Conditions

Refractory	Binder	Mixture	Burned in El. Fce., Deg. C.	Atmosphere When Burning	Results. Monolith.
EDB magnesia I.	Tar.	4-20 mesh magnesia, 9% tar.	1,500, rapidly.	Reducing.	Hard dense burn. Strong. Dark gray color.
EDB magnesia II.	Basic slag.	90 parts 4-20 mesh magnesia, 10 parts slag, water to moisten	1,500, slowly.	Oxidizing to start. Reducing at finish.	Hard, dense, strong, scratches glass, light gray color. Corroded by oxidizing slags.
EDB magnesia III.	Basic slag.	75 parts 4-20 mesh magnesia, 10 slag, 15 ground MgO bats, water to moisten.	1,500, slowly.	Oxidizing to start. Reducing at finish.	Did not sinter like II. Hard and stony, but not a coherent monolith.
EDB magnesia IV.	Basic slag, iron ore, tar.	85 parts 4-20 mesh MgO, 10 ore, 5 slag, sintered, crushed to 6 mesh, 9% tar.	Sintered at 1,800, Burned at 1,500.	Oxidizing at all times. Finish of burn reducing.	High shrinkage. Sluffed off. Metallic ring when cold. Granular, honeycombed. Corroded by oxide slags.
EDB magnesia V.	$MgCl_2$ sol. 35 Bé.	4-20 mesh magnesia, sol. to moisten.	Up to 1,500 slowly.	Reducing.	No bond. Friable. Crumbly.
EDB magnesia VI.	$MgCl_2$ sol. 25 Bé.	4-20 mesh magnesia, sol. to moisten.	Slowly up to 1,500 for 24 hr.	Reducing.	Hard, stony, well bonded, no shrinkage, no fusion, no cracks. Gray stony color.
EDB magnesia VII.	Boiled starch, hot sol.	4-20 mesh magnesia, starch to make stiff mud.	Up to 1,500 for 3 hr. reducing at 1,500 6 hr. on oxidizing and reduc. atmos.	Reducing and oxidizing.	Hard set in dry warm air, good firm structure, hard and stony when burned. In damp air disintegration set in. Crumbly. Not suitable for refractory uses.
EDB magnesia VIII.	Borax sol. sat.	4-20 mesh magnesia, solution to a stiff mud.	Dried 48 hr. at 150, gradually up to 1,100 for 6 hr. then to 1,600.	Reducing.	Hard compact structure. Corners friable, body dense, no shrink or expansion. Tumbled 1 hr. and only corners wore off to hard material 1 in. in from edge. Not breakable.
EDB magnesia IX.	39 Bé. sodium silicate sol.	4-20 mesh magnesia, sol. to a stiff mud.	Dried 3 hr. at 120. Burned slowly to 1,200, then to 1,600	Reducing. Strongly oxidizing at end of burn.	Close texture, homogeneous, hard. Flat surfaces, would scratch glass, no fusion. Texture about like best magnesia brick. No shrink. Hard burned.
EDB magnesia X.	26 Bé. NaOH sol.	4-20 mesh magnesia, NaOH sol. to stiff mud, rammed by machine.	Burned slowly to 800 for 2 hr. Cooled to 100. No bond. Heated to 1,500 1 hr.	Reducing. Oxidizing at end.	No cracks, hard and dense. No shrink, dark brown color, sharp corners, stony, close texture, no fusion, scratch glass.
EDB magnesia XI.	Plastic MgO Water as spray.	89 parts 4-20 mesh magnesia, 11 parts plastic MgO.	Dried 48 hr. 110 C. Slowly up to 1,500 C.	Reducing Oxidizing at end.	Very hard air set. Hard burned, dense, stony.
EDB magnesia XII.	Altered serpentine clay.	91 parts 4-20 mesh magnesia, 9 parts clay, water as spray.	Dried 72 hr. 110 C. Slowly up to 1,500 C.	Oxidizing. Reducing at end.	Very hard and dense. Strong structure. Stony. No fusion or cracks.
EDB magnesia XIII.	22 Bé. $MgSO_4$ sol.	4-20 mesh magnesia, $MgSO_4$ sol. to molding sand consistency.	Dried 90 hr. 150 C. 24 hr. 1,200 C. up to 1,500 C.	Reducing.	Slight cracks on surface. Very hard. Sharp hard corners, dense, stony, stands rough handling.
Zirconia XIV.	26.5 Bé. $MgCl_2$ sol.	100 mesh zirconia, mixed with sol. to a hard mud.	Dried 5 days 110 C. Slowly up 1,600 C.	Oxidizing at all times.	Hard, dense structure. No fusion. Stony hardness. FeO slag corroded surface. High density after burn.
Zirconia-magnesia XV.	26.5 Bé. $MgCl_2$ sol. to stiff mud.	50 parts 100 mesh zirconia, 50 parts 4-20 mesh magnesia.	Dried 5 days 110 C. Up to 1,500 C. 12 hr.	Oxidizing.	Fused to a spongy mass. Corroded by FeO slag. High silica content with magnesia formed sponge.
Zircon-magnesia XVI.	26.5 Bé. $MgCl_2$ sol. to stiff mud.	10 parts 100 mesh zircon, 88 parts 4-20 mesh magnesia, 2 parts 100 mesh silica.	Dried 5 days 110 C. 8 hr. at 1,500 C.	Reducing.	Very hard dense structure, sharp hard corners. No fusion by FeO slag. Tan color.
Zircon-magnesia XVII.	26.5 Bé. $MgCl_2$ sol.	90 parts 4-20 mesh magnesia, 3 parts 100 mesh zircon, 5 parts Fe_2O_3 ore, 2 parts 100 mesh silica, sol. to stiff mud.	Dried 5 days 110 C. 1,500 C. for 12 hr.	Oxidizing.	Equal to XVI. Dark color. Lighter in weight. The Fe_2O_3 not essential.
Zircon XVIII.	Floated clay.	Zircon concentrate mixed to stiff mud with clay emulsion.	Dried 110 C. 24 hr. Rapidly to 1,500 C.	Reducing to oxidizing.	Well bonded, no shrinkage, hard and glassy in spots, vitrified, vitreous to stony texture.
Zircon XIX.	Molasses water.	Zircon concentrate, mixed to stiff mud with molasses.	Dried 150 C. 24 hr. Rapidly to 1,500 C.	Reducing.	Good bond when burned at 1,500 C., friable at 150 C., stony gray color. Floated in melted steel bath. Not deformed or corroded.
Zircon XX.	Floated clay, dehydrated by suction.	Chemically refined zircon concentrate, mixed to stiff mud with clay and water.	Dried 150 C. 24 hr. Rapidly to 1,500 C.	Reducing oxidizing during burn.	Equal to XVIII. Hard stony to vitreous in small spots. Not affected by FeO slag.

carbon films remain to hold the particles in contact. The efficacy of these carbon films should not be undervalued, for they do compose good structural bonds, at the same time not entering into the refractory nature of the substance. It is essential, however, that conditions of burning the mass into place be carefully controlled. In burning-in ferrate bonds, the same carefully controlled conditions must be observed. In the case of the silicates and the aluminates, burning conditions do not affect the result to such a marked degree, being less in the aluminates than in the silicates.

Conditions Under Which Binders Were Tested

In Table I there are set down the various refractory substances, the binders used to bond them, and the physical state of the binding substance. This does not by any means represent all the substances that may find use as a bond for refractories, but it represents those that may be successfully used.

In Table II, 4- to 20-mesh magnesia refers to the EDB magnesia, ground so as to all pass a 4-mesh standard screen sieve and 50 per cent remained on the 20-mesh screen. The remainder would remain on 60-mesh.

Oxidizing conditions refer to a plenteous supply of air passing over the surface of the monolith or brick during the burning period.

Reducing conditions refer to the absence of excess air, and to prevent excess air, coke was placed in contact with the burning monolith or surrounding brick shapes.

The drying was done in a chamber of brick, heated out of contact with the gases of combustion of the heating fuel. Burning was done in the electric arc radiation furnace and any temperature was obtainable up to the temperature of the flaming arc of a steel-melting furnace. Conditions of the tests were maintained somewhat comparable to operating conditions in melting steel. Where monoliths were made, they were the walls of steel-melting furnace chambers. Where brick were made, they composed the walls in spots of a steel-melting furnace, and also were single specimens put inside the steel furnace when the bath was melted and the steel was being refined. It was desired to subject the tests to conditions similar to everyday steel-melting practice in an electric furnace.

Ink Specifications

Formulas for several types of inks are given in United States Government Master Specifications 163 to 166 inclusive, obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5c. per copy.

	Record and Copying Ink, Grams	Writing Ink, Grams
Tannic acid	23.4	11.7
Gallic acid crystals	7.7	3.8
Ferrous sulphate	30.0	15.0
Hydrochloric acid, dilute, U.S.P.	25.0	12.5
Phenol	1.0	1.0
Soluble blue, Schultz No. 539	3.5	3.5
Water to make 1,000 c.c. at 20 deg. C	...	...

Red Ink.—Dissolve 5.5 grams of crocein scarlet 3-B, Schultz No. 227, in 1,000 c.c. of distilled water.

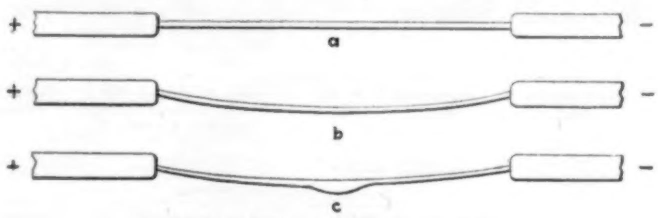
Stamp Pad Inks.—Dissolve 5 grams of dye in 100 c.c. of 55 per cent glycerine (sp.gr. 1.1415 at 20 deg. C.). Suitable dyes are: For black, nigrosine, Schultz No. 700; soluble blue, No. 539; light green, No. 505; magenta, No. 512; acid violet, No. 530.

Protective Coatings for Aluminum

By Carl Commentz, Dr. Ing.
Hamburg, Germany

There have recently been developed in Germany two new methods for providing aluminum articles with anti-corrosion oxide coatings. Both methods are electrical, but they are otherwise dissimilar.

The first, which makes use of strong electric currents for producing a high temperature, is based upon the following very interesting experiment: An aluminum wire is supported between two electrodes and a strong current is passed through it very suddenly. The temperature of the wire mounts rapidly and before the main body of the aluminum has melted the outer surface of the wire burns, forming an aluminum oxide. The oxide coating thus formed on the wire is so strong and tough that it will support the wire after the metallic portion has melted. A temperature of about 3,500 deg. F. may thus be held for several minutes, although the melting point of aluminum is only 1,220 deg. F.



Oxide Coating on Aluminum Wire

a—A piece of aluminum wire is connected between two electrodes. *b*—When the current is applied, the surface oxidizes and the interior melts. *c*—Liquid aluminum in oxide tube a moment before bursting

As the hot wire sags, the molten metallic aluminum inside the oxide tube flows to the center and by its "hydraulic" pressure bursts open the oxide tube. The experiment shows the toughness and uniformity of the oxide coating that can be formed upon an aluminum wire if it is heated electrically in the air.

The second method of providing aluminum with an oxide coating is electrolytic. The aluminum object to be coated is made the anode of a cell containing a saturated solution of borax maintained at a temperature of about 60 deg. F. A current of ½ amp. is passed through the cell and the voltage, which at the beginning should be about 4 volts, is gradually increased. Small oxygen bubbles are formed at the aluminum anode and soon a thin oxide cover is formed. The voltage is gradually increased and after 5 minutes, when the tension has become 150 volts, a blue color begins to become visible on the surface of the metal. This is an indication that the outside coating has reached a thickness of 0.0001 mm. The voltage is continually increased and the color changes several times as the thickness of the outside coating increases. At 300 volts the surface is a much lighter color. When the voltage has reached 480, it is maintained at that point. The outside coating has now become grayish white and has attained a thickness of 0.001 mm. For many purposes the coatings obtained at 120 volts are sufficient. When especially strong coatings are necessary, cooled concentrated sulphuric acid is used as an electrolyte instead of the borax solution.

The coatings obtained by the electrolytic process are not only protective in themselves but they make excellent intermediate coatings where paint is to be applied. If the coating is well washed and dried before painting, excellent adherence is obtained.

Producing Wax and Lard by Mechanical Refrigeration

The Separation of Paraffin From Petroleum Distillate and the Chilling of Lard Are Processes That Suggest Further Applications of This Unit Process

By H. J. Macintire
Associate Professor of Refrigeration, University of Illinois

Refrigeration—A Unit Process of Chemical Engineering

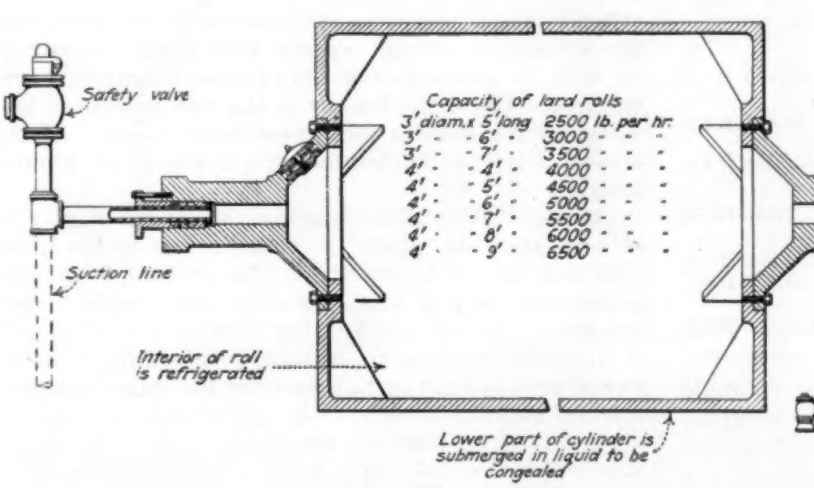
An article published in "Chem. & Met." Aug. 11, 1924, p. 229, described the process of removing salts from solution by mechanical refrigeration. The article herewith describes somewhat similar processes, that of removing paraffin from petroleum and that of recovering lard. While these processes are interesting in themselves, their chief value to the chemical engineer will be in the suggestions they carry for methods of usefully applying refrigeration in many other process industries.

IN THE last article of this series, the use of mechanical refrigeration in the separation of salts from solution—a method with extensive possibilities but of limited application up to the present—was described. Similar uses of refrigeration (in the broad sense) are in the so-called wax process of separation of the paraffin from mineral oil distillate during a certain stage of the refining of crude oil and in the congealing of lard in the packing house industry.

In each of these cases there is involved a cooling of the liquid and then the freezing of the wax or lard. The following matter is not given to explain these specialized cases only, even though they are common enough in the refrigerating industry, but also to show a method that can be worked out by the chemical engineer to suit his particular case, which may seem, superficially, to be entirely different from those cited.

In petroleum refining, in order to get the required "cold" test for certain grades of lubricating oils, it is necessary to chill the paraffin wax distillate and separate the resulting congealed paraffin out in a filter press. The problem involves the cooling of brine, as direct expansion is not often applied in this industry, and a suitable device for chilling the oil. Such a device is shown in Fig. 2.

The performances of heat transfer surfaces, the reader cannot be too strongly reminded, are absolutely dependent on the condition of the surfaces as well as on the velocity of flow past the two sides. The accumulation of scale, oil, ash, dirt, paste, air film, or, in this case, wax on these surfaces will materially decrease the tranfer, even when such accumulations are as thin as $\frac{1}{16}$ in., and will ultimately result in reduced capacity or complete failure of the plant. In chemical engineering, where much of the use of refrigeration is to congeal or precipitate substances, it is therefore paramount that the heat transfer surfaces be kept in good condition by prompt removal or cleaning.



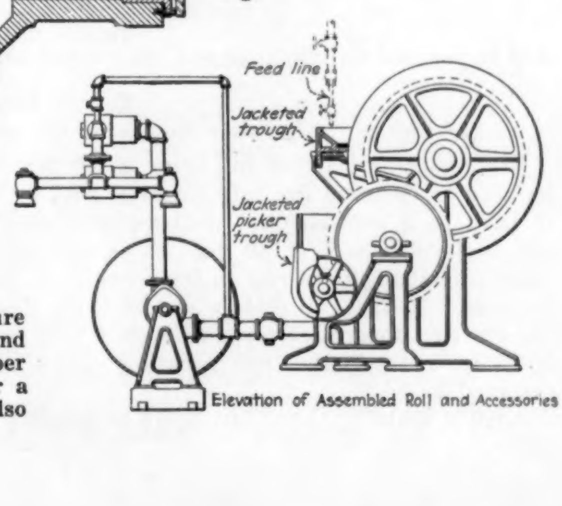


Fig. 1—Chilling Rolls for Lard Manufacture

These drums revolve at 10 to 14 r.p.m. and are kept at a temperature of 10 deg. F. in the interior. It freezes a thin layer of lard or compound as it dips into the fluid. It then revolves 270 degrees until the scraper knife releases the semi-solid and it falls into the picker trough for a thorough mixing. It is then ready for packing. These drums are also applicable in the soap and glue industries.

The amount of wax in the distillate varies for different fields. So do the physical constants, but the average may be taken as 0.5 for the specific heat of the oil and 0.87 for the specific gravity. The latent heat of fusion of the paraffin is 60 B.t.u. per pound, which begins to separate out at 60 deg. F.

For example, let us assume that 1,000 gal. of distillate per hour is to be cooled from 80 to 20 deg. F. and 10 per cent of wax by weight will be removed. Assume the specific heat of the solid paraffin to be 0.6. The weight of the oil handled per hour is 1,000 × 7.48 × 0.87 = 6,510 lb. Then the amount of refrigeration required may be found by the following calculations:

(*a*) To cool the oil to 60 deg. F.

$$6{,}510 \times (80 - 60) \times 0.5 = 65{,}100 \text{ B.t.u.}$$

(*b*) To freeze the paraffin

$$0.1 \times 6{,}510 \times 60 = 39{,}000 \text{ B.t.u.}$$

(*c*) To cool the oil

$$0.95 \times 6{,}510 \times (60 - 20) \times 0.5 = 123{,}600 \text{ B.t.u.}$$

(*d*) To cool the wax

$$0.05 \times 6{,}510 \times (60 - 20) \times 0.6 = 7{,}800 \text{ B.t.u.}$$

Total = 235,500 B.t.u.

Add 10 per cent for insulation and other losses 23,600 B.t.u.

Total = 259,100 B.t.u.

= 21.6 tons of refrigeration required of the compressor.

The resulting clarified oil, being at 20 deg. F., could be used to decrease the refrigerating load by pumping it back to a counter-flow, double-pipe cooler through which the distillate at 80 deg. F. is also passed, and there permitting it to rise in temperature to 40 deg. F. or more. In fact, oil coolers are at times designed to use the two uppermost pipes as such a heat exchanger. By this method, the refrigeration saved might be expected to be

$$0.9 \times 6{,}510 \times (40 - 20) \times 0.5 = 58{,}600 \text{ B.t.u.}$$

The saving of this heat will lessen the refrigeration required from a compressor to:

$$\frac{1.1 \times 176{,}900}{12} = 16.2 \text{ tons of refrigeration.}$$

But the oil cooler would be less efficient in heat transfer, because of having oil on both sides of the inner pipe and also because of the lesser temperature difference when using oil and brine for cooling rather than brine throughout the cooler.

As a rule, zero degree brine is used in these coolers. For some time the absorption machine has been the favorite means of securing refrigeration, because exhaust steam is always available in oil refineries, for the absorption system can use this steam directly in its still to generate the high-pressure ammonia gas required. The brine for use in the wax process is best cooled by means of a multi-pass brine cooler. At the present time the horizontal type is the most popular design.

The distillate chilling machine shown in Fig. 1 is of 4-in. and 2-in. pipes, the brine being in the outer pipe and the oil in the inner. The amount of ocoling surface is more or less empirical. One refinery uses 400 linear feet of cooling pipe surface to cool 20 gal. of distillate from 80 to 20 deg. F. per minute, using zero degree brine. In this problem the mean temperature difference is

$$t_m = \frac{(80-5)-(20-0)}{\log_e \dfrac{80-5}{20-0}} = 41.6 \text{ deg. F.}$$

with a rise of 5 deg. in the temperature of the brine from 0 to 5 deg. F. Using a value of $k = 25$, the surface becomes

$$\frac{235{,}500}{25 \times 41.6} = 226 \text{ sq.ft.}$$

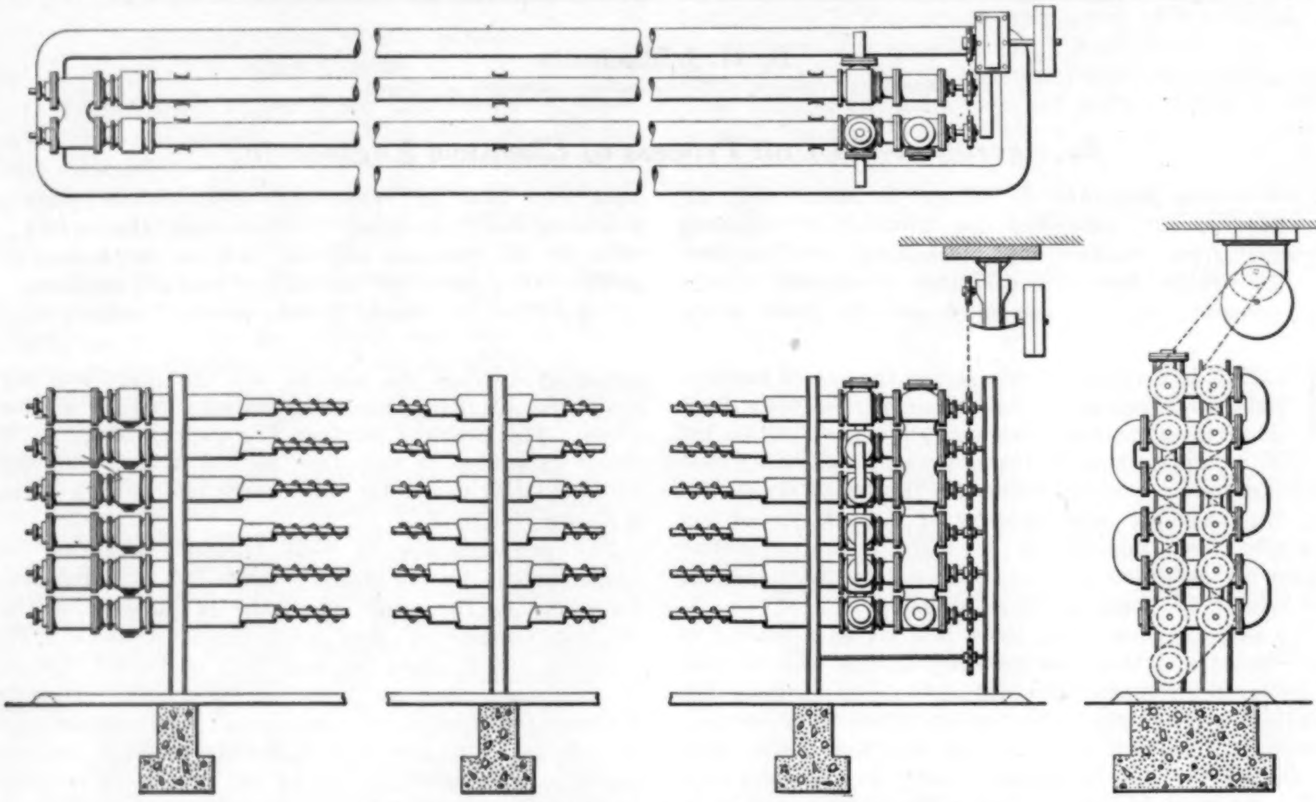


Fig. 2—Double Pipe Oil Cooler for Paraffin Removal

As the wax congeals, the screw conveyor in the inner pipe scrapes the heat transfer surfaces clean of it and pushes it in the direction of oil flow. This construction gives a positive flow of oil and a clean heat transfer surface.

which is equal to $226 \times 1.6 = 362$ ft. of 2-in. pipe, using the outside surface of the pipe, which is the usual custom of refrigerating engineers. The value of $k = 25$ is of course satisfactory only when the inner pipe is of uniform cross-section and when the screw conveyor fits well and keeps this inner pipe scraped clean.

The Lard Cooling Process

In a number of industries deep well water can be used for the desired cooling. However, such cooling is often not speedy enough. Hence mechanical refrigeration is useful for the quicker accomplishment of the cooling and is coming more and more into use. Also, mechanical refrigeration often gives an improved product, due to control of temperature and speed of operation. This is particularly true of the manufacture of lard and lard compounds.

In the manufacture of lard the trimmings and other fat parts of the hog are steamed in a rendering tank under 40 lb. steam pressure for from 7 to 9 hours. The resulting liquid lard is then mixed with fullers earth for a few minutes and is filtered in a filter press. The filtrate is stiffened by adding not more than 5 per cent of lard stearine and is then cooled from about 140 to 80 deg. F. by means of water and from 80 to 40 deg. F. by means of mechanical refrigeration. Compounds are made by using beef fat, cottonseed oil and pork fat. In making such compounds the refined fats, in hot, liquid state, are mixed, filtered and then cooled mechanically. In cooling both lard and lard compounds, drums such as are shown in Fig. 1 are used.

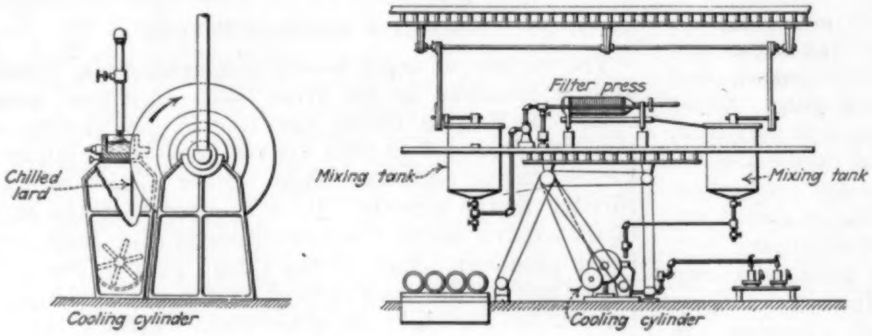


Fig. 3—Layout of Lard Cooling Plant

In this sketch can be seen the filter press, mixing tanks, chilling drum and final mixing trough as described in the caption to Fig. 1.

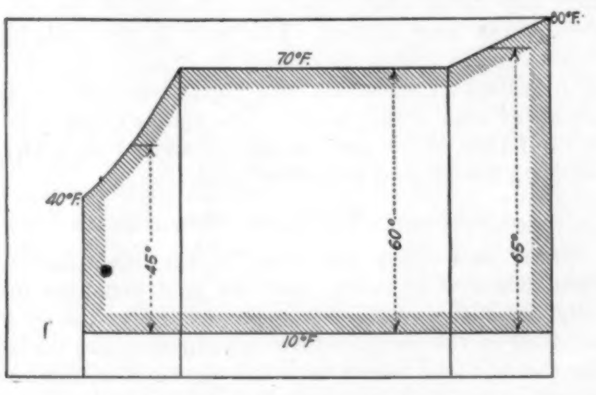


Fig. 4—Graphical Determination of the Temperature Differences in Lard Cooling

This curve illustrates the method of cooling the lard which is described in the example in the text.

The physical constants for lard vary somewhat, but the following is accepted practice: Weight, 59.3 lb. per cu.ft.; specific heat, 0.5 to 0.6; latent heat of fusion, 90 B.t.u. per lb. The melting point is 70 deg. F. for lard and 105 deg. F. for tallow. Lard compound has a weight of 57.5 lb. per cu.ft., a specific heat of 0.3 to 0.5 depending on its fluidity, and the latent heat of fusion is the same as for lard, 90 B.t.u. per lb.

Suppose we wish to cool 6,000 lb. of lard per hour by means of brine at 10 deg. F. to a temperature of 40 deg. F. Then the refrigeration required would be:

$$6{,}000 \times 0.5 \times (80 - 40) + 6{,}000 \times 90 = 660{,}000 \text{ B.t.u.}$$

$$\frac{660{,}000}{12{,}000} = 55 \text{ tons of refrigeration.}$$

Add to this 10 per cent for losses and the refrigeration becomes 60.5 tons at the compressor.

If the chilling cylinder is 4 ft. diameter and 9 ft. long, the face of which is 90 per cent efficient as a cooling surface, then

$$k = \frac{660{,}000}{t_m \times area}$$

where the area = 102 sq.ft. and the mean temperature, $t_m = \dfrac{45 \times 9 + 60 \times 90 + 65 \times 5}{104} = 58.9$ deg. F.

Therefore $k = \dfrac{660{,}000}{102 \times 58.9} = 109.9$ B.t.u. per sq.ft. per deg. difference per hour.

This figure appears large and can be obtained in practice only when the scraper knife keeps the surface clean.

The compressor is required to deliver 60.5 tons of refrigeration and for 10 deg. F. brine the boiling temperature of the ammonia must be approximately zero deg. F. Using a standard condensing temperature (86 deg. F.), the theoretical piston displacement becomes

$$60.5 \times \frac{200}{611.8 - 138.9} \times 9.116 = 233 \text{ cu.ft.}$$

The volumetric efficiency of an ammonia compressor for these operating conditions, assuming no clearance and tight valves and piston rings, is about 0.82. The corrected piston displacement then becomes 284 cu.ft. per minute. A compressor to give this result should be chosen.

Industrial Gas Booklets

As a basis for education of industrial gas salesmen, the American Gas Association is preparing a series of industrial booklets. Two of these, on the subjects of "Combustion" and "House Heating," have been issued. The report on "Baking" is in press and a preliminary draft has been submitted for "Ceramics," "Drying," "Food Products," "Metal Melting," "Tank Heating," "Forging and Heat-Treating," and "Heat Control." These booklets will be available for purchase at the association headquarters, 342 Madison Ave., New York City, as soon as printing is complete.

Some Notes on Copal Gum

The Third and Last Article on Fossil Gums Tells of the Somewhat Mysterious Article of Commerce That Comes From Savage Tribes All Over the World

By W. M. Myers
Assistant Mineral Technologist, New Brunswick Station, Bureau of Mines

THE TERM copal is used very loosely and is applied to practically all fossil resins other than amber and kauri. Some copals are not true fossil resins, and should be classified more strictly as bush gums. Copal is found in widely distributed localities, and curiously, all the deposits that furnish commercial production are located in regions so remote from modern civilization that the industry of collecting the gums is almost entirely in the hands of people who are still living in a semi-savage state. As a result very little is known concerning the occurrence and production of these gums. The most important copals of commerce are classified as Manila, East Indian, Pontianak, Congo and Zanzibar, according to the localities from which they are exported.

How the Gum Is Obtained

Practically all Manila gum is exported from Manila, Singapore, Batavia and Macassar. The term may therefore be considered as a collective one, and is applied to a medium hard resin produced in the islands of the Philippines, Malasia and part of the East Indies. At least four varieties of resin-producing trees flourish in this district, and as their products are collected and graded by primitive methods, and mixed in irregular proportions, Manila copal occasionally displays an undesirable lack of uniformity. What proportion of Manila gum may be considered a true fossil resin is unknown. In some districts it is known that 90 per cent of the gum produced is obtained by bleeding the trees, and it is probable that this type of gum predominates. This mixture of bush and fossil gum may account for the irregular solubility of Manila gum.

The actual collection of the gums is made by the hill tribes, who carry on the work in a most irregular and primitive manner. The bush gum is obtained by gathering the yield from incisions hacked in the trunks and roots of the trees. Excavations around the roots of the trees sometimes disclose large masses of gum. The fossil variety is recovered by small excavations made in the soil where the decayed stumps or other indications show that the trees once stood. Prospecting for buried deposits where no surface indications exist is not considered practicable. In digging the gum the earth is loosened with a bolo and then scooped out with a coconut shell. The gum is sacked and eventually taken to the nearest town, where it is sold or bartered to the traders, who are generally Chinese. After passing through several hands the gum arrives at one of the larger ports, where it is sorted and graded for export.

Dammar is a bush gum harvested regularly from the trees in the Straits Settlements. Closely related to it is the East Indian gum, which is believed to be nothing more than fossilized dammar. It is exported principally from Singapore, where the production from many irregular trading channels is centralized. Little is known concerning its production, but it is generally believed to be a native industry similar to the collection of Manila copal.

Pontianak gum is collected in Borneo, and from its appearance and the little that is known concerning its occurrence is believed to be a true fossil gum. The material is collected by native traders and eventually finds its way to Singapore, where it is assembled and prepared for export.

Primitive Methods Prevail

The variety of copal known commercially as Congo gum is produced on the West Coast of Africa, principally in Belgian Congo and Angola. A variety of gums is produced in this district, and their mixture by the native collectors tends toward a lack of uniformity in the exports. It is believed that the bulk of the exports are of the fossil variety, little bush gum being produced. Most of the Congo gum is found in sandy soil of the bush-covered plains at an elevation below 2,500 ft. Like all other copal districts, the industry is carried on in a primitive manner by the natives. Considerable gum has been found in localities where the sandy soil has been removed by the rains. The natives prospect these localities where gum has been found on the surface and recover as much from the soil as is possible with their shallow workings. The gum is bartered with the traders and assembled at the posts, where it is cleaned and graded for export. Prior to 1914 practically the entire production was shipped to Antwerp and there re-exported. Since that time shipments have been made directly to the United States and the consumption of Congo gum has greatly increased. The reserves in the Congo district are undoubtedly enormous, sufficient to supply industrial demands for many years.

The copals exported from Zanzibar and known commercially under that name are collected in British and Portuguese East Africa. The bulk of this gum is the fossil variety and is recovered by digging shallow pits in localities from which the copal tree has in many instances long disappeared. The industry here is also in the hands of the natives and is carried on with typical irregularity and primitive tools.

Use and Value of Fossil Gums

Kauri and copal are used in the manufacture of varnishes and linoleum, markets that consume practically the entire production. The extensive use of china wood oil in the manufacture of varnishes has decreased the use of fossil resins, and the market for them would be restricted if it were not for the growth and expansion of the entire varnish industry. Other gums are utilized in the manufacture of varnish, and an idea of the size of the industry may be obtained from the figures representing the imports into the United States for the year 1923 from a few of the producing countries, as given by the Bureau of Foreign and Domestic Commerce:

	Lb.	Value
Belgium (mostly Congo gum)	9,240,720	$608,623
British India	4,491,100	1,304,205
Straits Settlements	5,262,590	523,096
Java, Madura	10,141,724	674,231
Belgian Congo	1,499,529	57,583
New Zealand (kauri)	8,228,520	1,889,789

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Where Is It Profitable to Use Gas?

A Subject of Great Importance to All Technical Men and One of Those Discussed by the American Gas Association

Editorial Staff Report

AT THE sessions of the American Gas Association's sixth annual convention in Atlantic City, N. J., almost every phase of the business was considered. The growth of the association was well demonstrated by the necessity of simultaneous sessions on accounting, commercial problems, industrial gas, advertising, and technology. Two of these groups had under consideration at practically every meeting problems of great importance to the chemical engineer and the industrial chemist, for gas engineering is more and more coming to be simply one type of chemical engineering and the use of gas is rapidly permeating all industry.

Maintenance of Adequate Gas Supplies

With the rapid increase of industrial use of gas has come an urgent demand for greater gas-making capacity. Every year the management of large companies is confronted with increases in plant and distribution systems, in many cases regularly exceeding 15 per cent per year. As a consequence one of the most important problems of management today is the choice of equipment by which the added quantities of gas can be made. This same problem is also increasingly important in territory where natural gas has previously been supplied, for there the waning natural gas must be supplemented or superseded by manufactured gas.

Discussing the "best type of manufactured gas plant for natural gas companies required to augment failing supplies of natural gas," Alfred Hurlburt, vice-president of the Equitable Gas Co., Pittsburgh, brought out some of the fundamental economic considerations that determine choice of gas-manufacturing systems. He pointed out that the purveyor of natural gas at current prices for this fuel can never afford holders for natural gas or for manufactured gas to supplement natural gas. Only so fast as the public is taught to accept proper gas rate schedules can the extension of manufactured gas into natural gas territory be accomplished. The only practical storage for natural gas yet discovered is under ground, either at the point of occurrence or in nearly exhausted wells near the point of use, according to the system developed in Buffalo.

Much of the discussion of this subject hinged on the question, Will house heating be continued in natural gas districts when manufactured gas is substituted? The discussion was equally applicable to the industrial gas user who has been blessed with cheap natural gas supplies, but who now finds his supply curtailed. T. R. Weymouth presented a careful analysis of the situation based upon his experience in the Buffalo district. He forecasts that combination systems will be developed whereby all of the business that can logically be attracted at proper rates for manufactured gas will continue and only large industrial users and wasteful house-heating operations will be cut off.

As pointed out in the news report of the convention, J. B. Klumpp, president of the association, emphasized the increasing use of coke-oven gas for city supply. This same question was freely discussed in several of the technical sessions also. Perhaps the best summary of the real problem in this field was presented in the report of the coke committee.

"In spite of the fact that there are many companies that realize the value of a progressive coke policy, the general tendency throughout the industry is to let well enough alone. When the gas managers appreciate that the gas-consuming public supports the coke-consuming public, there will be a cry for a greater residual return on coke than at the present time, which, generally speaking, is possible only when the same care and attention that is given to the production and distribution of gas is given to coke.

"The coke committee feels that the future of the coke industry is dependent, to a large degree, upon the attitude taken by the gas engineers of today. That the sendout of gas will materially increase year by year is quite evident. It is also evident that a reasonably large percentage of new gas-producing equipment will be for coal gas. This in itself is indicative of the need of a complete understanding by the members of the gas fraternity of all matters pertaining to the production of coke and the development of the coke market."

Coking Test Code

D. W. Wilson, of the Iroquois Gas Co., Buffalo, reported for his sub-committee on a standard carbonizing plant test code. This code has been drawn up as a guide for plant tests to determine operating efficiency or acceptance of plants under construction guarantees. The code is accompanied by full instructions and the necessary tables to make it a real guide in such work. Those having such tests to conduct can secure copies of the report from the association headquarters, as this report was preprinted for the convention.

Coal Gas Operating Results

W. D. Stewart continued the service of this committee during previous years in a summary of actual carbonizing plant results obtained from about 40 per cent of all the coal gas plants operating in the United States. Very complete data were requested from more than 200 such plants and of these 77 gave sufficient information to justify publication. As a result an excellent and representative summary of the whole industry is available, from which one may determine operating practice and efficiencies.

Only limited replies were made on the subject of complete gasification and on low-temperature carbonization. The former subject is more completely covered in connection with studies of water-gas manufacture which have been under a separate committee of the association.

Operating and labor-saving devices came in for considerable attention. Reduction of standpipe labor by circulating liquor and by use of scrubber-type or sprayed equipment, as well as power-driven standpipe cleaners, was described by the sub-committee under S. B. Sherman. Charging and discharging machines, including coke pushers for vertical retorts, received more than usual attention. Other developments described and pictured by this committee were: Self-sealing doors, hydraulic main governors for small plants, fuel- and ash-handling machinery, oxy-acetylene and electric welding and cutting equipment, compressed air for stoppage removal, recording calorimeters and liquid purification.

Carbonization Report

Continuing the policy of previous years, the committee on carbonization and complete gasification of coal, under the chairmanship of E. H. Bauer, presented a number of fine technical reports on problems of operation, on low-temperature carbonization and on new engineering construction. The first of these sub-committee reports included a comparative test of run-of-mine and screen coal made by F. D. Lohr and A. M. Beebee. This work was a continuation of that given last year by Professor Demorest. Five plant-scale tests each on thousands of tons of coal gave average comparative yields as follows:

	¾ in.	Run-of-Mine
B.t.u. per lb. coal	3,200	3,151
Gal. tar per ton	13.5	10.4
Lb. NH_3 per ton	4.57	4.23
H_2S per 100 cu.ft. gas	428	460

The averages are undoubtedly in favor of lump coal in each case, but the committee warns against the generalization that the lump coal is better than run-of-mine in all ways. Often the lower cost of run-of-mine coal is sufficient to justify consideration of that material, despite the slightly lower yields. Therefore the committee concludes that "plant yield is but one of the many factors to be considered in a dollars-and-cents analysis of the problem."

Coke Preparation and Sale

The coke committee during the past year has made its first objective the development of interest among gas men in coke as an essential element in future gas production. They stress in their report also methods of coke manufacture and the importance of proper sizing of coke for sale. A. W. Grant, Jr., presented for the committee an exceptional technical summary of the problems of selection and preparation of coal as affecting coke quality. This report contains numerous charts and many figures essential to its use, so that it is impractical to review it adequately in brief space.

H. J. Rose also reported for the committee, with particular attention to coke combustibility, standardization of coke sampling and testing, and to recent progress in systematic study of the nature and properties of coke. He pointed out that there is no accepted meaning for the term combustibility, despite the fact that this property is of fundamental importance in determining the value of a coke as an industrial fuel.

Another technical supplement to the coke committee report dealt with methods for improving the quality of coke produced in horizontal gas retorts. Numerous illustrations of cokes and summaries of operating data add to the value of this communication. It is pointed out that without pulverization the improvement desired in coke quality can rarely be obtained in full, even with normal percentages of low volatile coal. Furthermore, comparison between two plants or two coking processes must be very carefully made, since often two different coals are needed to take advantage of the merits of two different coking processes. The committee points out that "it should always be borne in mind that in comparing the various types of coke-producing plants it is necessary to consider many features, such as the percentage of salable coke produced from particular coals, the price which the coke will bring, the range of coals which can be successfully coked, the variations in coke which can be produced to meet changing market conditions, etc."

Merchandising coke from the small plant, advertising and mechanical handling methods were also discussed at length in the committee report. From these sections it is evident that the industry is going to give much more attention in the future to coke disposal, both for industrial fuel and for household uses. The result will undoubtedly stimulate coal-gas manufacture and the wider application of industrial gas and of coal-gas coke (as distinguished from oven coke) for industrial applications.

Low-Temperature Carbonization

Explaining the limited service that can be rendered at this time by committees on low-temperature coking, Prof. S. W. Parr pointed out that this phase of coal processing is now in a stage of development. This makes a complete report either impossible or undesirable; the reasons for this were explained by Professor Parr as follows: "In the first place, those processes which are just entering upon an industrial status, and there are a number of them, are not willing, nor is it wise at such a time to urge the investigators to say what they are going to do. As a matter of fact, this feature will fall much more appropriately as an inheritance to the next committee. Then, too, just at such a stage the statements of the promoters, even though well assured in their own minds of their ground, would of necessity take on more or less the aspect of boasting, and it is far better to boast at the time of putting off the armor than when it is being buckled on. But do not interpret this situation as a discouraging sign. On the contrary, it has a distinctly hopeful aspect."

Mechanism for Gum Formation

A summary report was presented by Dr. R. L. Brown of several years work on gum formation from the hydrocarbon constituents of gas. This work has been addressed particularly to prevention of gummy deposits in gas meters, but some of the principles established appear to be broadly applicable to the gum-forming constituents that occur in the products of oil cracking. The results of this investigation are recapitulated in the following summary, which also seems to answer the four basic questions of the investigation:

1. Gummy meter troubles are due to the unsaturated hydrocarbons which condense and collect in the pipes and meters.

2. Oxygen is a general factor in gum formation and subject only to the presence of unsaturated hydrocarbons. It appears that the average oxygen input in the purifier box is generally in great excess of that actually consumed in the oxide boxes.

3. By survey of a considerable number of plants it

was pointed out that the presence of gummy deposits paralleled very closely the high rates of oil input, and in general was associated with relatively low cracking temperatures and with incomplete and non-uniform cracking of oil. Gas oils of different properties cracked under the same conditions give different amounts of gum-forming constituents in the resultant oil gas.

4. Variation in cracking temperatures exerts a very marked influence on the amount of unsaturated material in the gas, and specifically on the amount of gum-forming constituents. Incomplete cracking or non-uniform cracking (as evidenced by the presence of gum-forming constituents) result (1) from low cracking temperatures, (2) from excessive rates of oil input (too short a cracking period) or (3) from insufficient contact. A combination of two or more of these factors may often be involved. The factors are interdependent and within limits one may give aid to or compensate for another.

Gas Compression Costs

The distribution of high-pressure gas for industrial and commercial purposes and as a supplement to the general low-pressure supply of cities has engaged the attention of a committee under the chairmanship of R. S. Fuller. This committee points out that gas men are beginning to realize that such supplemental high-pressure systems are essential if they are not to lose the business in many industrial plants where high-pressure gas is needed but where compressors located on the premises of the customer are not desirable. Industrial plants desiring such high-pressure service will do well to call the attention of their local gas company to the emphasis given this subject by the association committee.

> "Only too often we find a pile of brick with a pipe inserted masquerading as a furnace." In other words, look to furnace design and manipulation as well as to the fuel. J. H. Gumz described a gas-heating installation in a large forge, where furnace design played fully as important a part as the gas in the success of the undertaking. This is a suggestion that will merit the consideration of all plant managers.

The cost of gas compression as affected by the quantity of gas handled, the pressure to which it is compressed and the distance over which it is transmitted has been carefully analyzed by Mr. Fuller, who presented graphical summaries based upon typical operating costs. These data are apparently equally applicable to questions of gas compression for industrial purposes, where chemical gases or other fuel gases are involved. The full report has been printed and is available from the association headquarters.

Soil Corrosion of Piping

The distribution committee report was this year made up largely of replies from all parts of the country as to actual experience with underground pipe systems. A great deal of space is given to a discussion of the relative life of steel, wrought iron, sand-cast iron and centrifugally cast iron when exposed to soil corrosion. The committee finds it impossible to generalize fully on this experience, and reaches the practical conclusion that there is no marked difference in the life of the different kinds of pipe as indicated by the reports of gas companies. The one important exception to this appears to be in favor of wrought iron as compared with steel for service pipe. In all cases, however, coatings and protective covers are much more important factors in lengthening the life of a pipe. In discussing the question of high-pressure lines interest in welded cast-iron pipe lines was exhibited, with special reference to the new Tobin-bronze joint. Replies also imply a preference for welded joints, because of greater corrosion resistance and greater relative strength, as compared with screw joints.

The chemical committee in its consideration of corrosion problems gave special attention to the influence of oxygen in gas upon its corrosion effects. Though only small decrease in oxygen content from the plant to outlying points on the distribution system has been discoverable, it is pointed out that this small difference of 0.05 per cent would be equivalent to the formation of 180 lb. of iron oxide from each million cubic feet of gas per day sent out. It is argued, therefore, that the use of air in gas purifiers should be kept down to the very minimum possible with successful purification.

Use of Gas by Industries

The industrial gas section of the association, although the youngest division of all, had one of the most successful programs under the chairmanship of H. H. Clark of Chicago. Opening this session Mr. Clark pointed out that the gas industry now does approximately 50 per cent of the possible household business for cooking, water heating and laundry work, but certainly not more than 10 per cent of the large industrial business. This makes it clear that the great increases that will occur in the industry in the near future will undoubtedly lie in industrial applications of gas. The limit forecast by Mr. Clark is the rate at which the industry can secure new capital in order to enlarge the gas-making and the gas-distributing facilities needed to meet this demand.

The important problem of the relations between industrial plant management and both gas company and builder of industrial gas furnaces aroused quite a controversy in the sessions of this section. It is recognized that large expenditure must often be made in order to develop suitable gas-burning equipment for new types of industrial heating. The division of this expense between gas company and gas appliance builder is the real root of the difficulty. The association work promises to solve many such problems by making available to all gas companies and to all prospective users of industrial gas the experience in all parts of the country; thus each new problem is simplified by a knowledge of successful gas-heating methods employed in other industries or other plants of the same industry.

Discussing industrial heating in an excellent article entitled "Gas Is Cheaper," J. H. Gumz, of San Francisco, offered both a warning against extravagant claims for gas as an industrial fuel and specific examples of the proper method for determination of the cases where it is true that gas is cheaper. One of the examples where the answer was negative is described by Mr. Gumz as follows:

"Some time ago we were asked to install gas in place of fuel oil in a fruit dehydrator. The use of fuel oil

sometimes left a very minute film or coating of oil on some of the product. This was objectionable and it was in an endeavor to eliminate it that gas was resorted to. Dehydration of fruit is accomplished at a very low temperature, sometimes as low as 130 deg. F., and consequently with properly designed equipment excellent efficiencies can be obtained. In this particular case it was soon discovered that the gas consumption would run over 2,000,000 cu.ft. per month. At an average rate 90c. per thousand this would have been an excellent piece of business, even though the season lasted for only 3 months. Unfortunately it was apples that were being dried and as something like 80 per cent of the weight of raw apples is water, the 2,000,000 cu.ft. of gas used to evaporate this large quantity of water would produce only about 45 tons of dry apples. The use of gas increased the cost of producing the dry apples about $33 per ton, which might have been charged against improved product, as the dry apples surely were clean. However, the selling price of this fruit is governed largely by marketing associations, so the operator was placed in a position of increasing his costs $33 per ton without being able to increase his income to offset it. At that time the market price of dry apples was particularly low, being only about $100 per ton. If it had been walnuts instead of apples that were being dried it would have been a different story, as the cost of gas per ton would have been only about $10 against a market price for the product of $300. So before deciding to go after business it would be well to consider whether the user is in control of all factors entering into the operation of his business."

Gas Successful for Industrial Heating

To show that it is a real engineering job to determine the probable success of gas as an industrial fuel, Mr. Gumz describes the procedure undertaken by his company to study the firing of two tunnel kilns used for sanitary ware in which the estimated gas consumption will be 15,000,000 cu.ft. if the business can be demonstrated to be profitable for the ceramic manufacture involved.

"Detailed plans have been made whereby we will make a complete study of every phase of the plant operation. Costs will be determined covering the making of the ware, the firing, the making of saggers, etc. Then a careful check will be kept for one month on the operation of the kiln when fired with oil. An observer will be on each 8-hour shift throughout the 24 hours of the day. He will keep a log of the temperatures, the quantity of ware entering and leaving the kiln, marked saggers will be used to determine the life and tab will be kept on the breakage of saggers. The ware is all graded *A*, *B*, *C* and spoilage by inspectors. A daily record will be kept of this. After running a month on oil the kiln will be switched over to gas and the same data taken for a like period of time. Every detail involved, in so far as can be predetermined, will be kept check of and at the end of 2 months no difficulty should be experienced in deciding whether or not gas is cheaper. It may appear that a load of 15,000,000 cu.ft. per month and a gas bill of $10,000 would be a hard proposition to sell, but even a casual study will show that it is well within the possible. The two kilns referred to have a daily output of approximately 550 pieces of ware. This sells at an average of about $10 per piece of *A* ware and $7.50 per piece of *B* ware, and about $6.50 per piece of *C* ware. If the quantity is each grade is increased by twenty pieces and the spoilage, by the same token, reduced by twenty pieces, it would mean an increase in value of marketable product of $200 daily, or $6,000 per month. Saving about 3 per cent from spoilage and bringing it through as class *A* ware would have the same effect. The $200 daily would go a long way toward paying the increased fuel cost. And it still remains to consider possible savings in saggers as well as convenience, cleanliness, etc."

Two of the most elaborate committee reports presented at the convention dealt with methods for the manufacture of gas, one from the builders' section of the committee on water gas, the other from the committee on carbonization, builders' section. These two reports are made up of descriptions of recent developments of representatives of practically all of the important companies that build or erect gas-making machinery or plants. Taken together, the two reports give the best possible résumé of the progress made by the industry during the past year, for each company describes typical construction work which it has done during recent months. The reports are, however, far too elaborate to permit review within the space of a convention report.

Combustion of Coal in Storage

S. W. Parr, discussing the deterioration and spontaneous combustion of coal in storage, stated before the gas and fuel chemists at the Ithaca meeting of the American Chemical Society that the conditions concerning the heating of coal in storage may be summarized as follows:

1. A high percentage of textural moisture in a coal indicates a high capacity for oxygen absorption. Such coals immediately upon breaking out from the seam begin to lose moisture until an equilibrium with the moisture of the atmosphere is established, thus making way for the accession of oxygen.

2. The larger the lumps of coal the slower the interchange as between the free or inherent moisture and oxygen. Conversely, the more finely divided the material the more rapid the interchange and also the greater the superficial area of the coal particles.

3. Any departure from normal temperature upward, unless checked or dissipated, is a vital factor, whether such increase of temperature arises from external sources or is the result of chemical combinations within the coal itself.

4. Accessibility of air within the coal mass, thereby augmenting the supply of oxygen beyond the amount taken up by absorption, is essential for carrying the oxidation forward, thus bringing the temperature of the mass up to the point of ignition.

5. Accessibility of air involving ready circulation to an extent that will carry away the initial increments of heat as rapidly as formed will prevent a rise of temperature.

6. Complete prevention of an additional oxygen supply beyond that absorbed by the coal before entering the storage pile will insure against any appreciable or dangerous rise of temperature.

7. The oxidation of pyritic sulphur requires the presence of free moisture as well as oxygen. The augmenting of the heat in any manner greatly accelerates the oxidation processes for both the hydrocarbon and the sulphur components of the coal.

Equipment News

From Maker and User

Automatic Temperature Control

Not the least interesting thing about the automatic temperature controller described in this article is the method of marketing adopted by the manufacturer, Wilson-Maeulen Co., Inc., 383 Concord Ave., New York. This policy is best embodied in the words of the president of this concern, whom we quote:

"The application of automatic temperature control to industrial heating is not alone a matter of automatically opening and closing fuel valves in response to temperature changes, for many other factors are involved. Automatic temperature control should not be interpreted simply as automatic control of good furnace output, for in most cases furnace atmosphere, the time element in heating, uniformity and fuel constancy enter largely into the matter. It is therefore our belief, after thorough investigation, that control equipment should be applied by engineers specializing in that work.

"In the case of new furnaces, the manufacturer or builder of the furnace should select and apply the control equipment in its entirety, including the power-operated valves, as well as the temperature-actuated control mechanism. On old or existing furnaces or on processes already in operation, either the original builder of the furnace or an engineer specializing in this work should be called upon.

"This is the only way by which all the elements affecting results can be cared for, and successful results secured. This engineering is necessary and is not included in the prices of this control equipment."

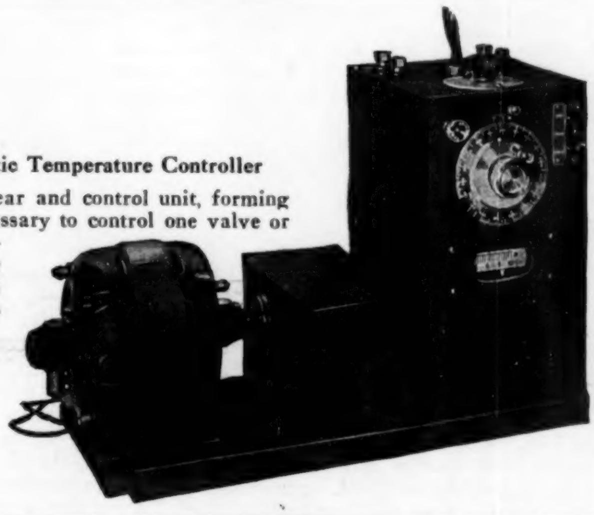


Fig. 1—Automatic Temperature Controller

Motor, reducing gear and control unit, forming the equipment necessary to control one valve or switch. Other control units, up to five additional, may be operated from this same motor.

The device to which the above remarks refer is perhaps as novel as the marketing scheme outlined. In the first place, it is built in units, each to operate one control, and as many as six of these units may be driven from the same motor and gear system, thus insuring uniform control of fuel valves, steam valves or electric switches in multiple.

The single control unit is shown in Fig. 1, together with motor and reducing gear. Fig. 2 shows the inside mechanism and the caption of this figure explains the operation. The unit is actuated by a thermocouple circuit. Either base metal or platinum-rhodium thermocouples may be used as conditions require. The motor used is a standard ¼-hp. motor. The reducing gear is a double worm and wheel reduction running in an oil bath. It drives the control unit through a readily detachable link fitting into the slotted ends of the shaft projecting from the gear box and the shaft projecting from the control unit. This shaft projects through the unit and is slotted on each end and it is by means of these slotted shafts and detachable links that a series of units can be connected to the same motor.

All of these units and these parts are interchangeable. The standard cycle of operation is 10 seconds, but a longer cycle up to 20 seconds may be specified. The machine is designed so that no auxiliary circuit passes through

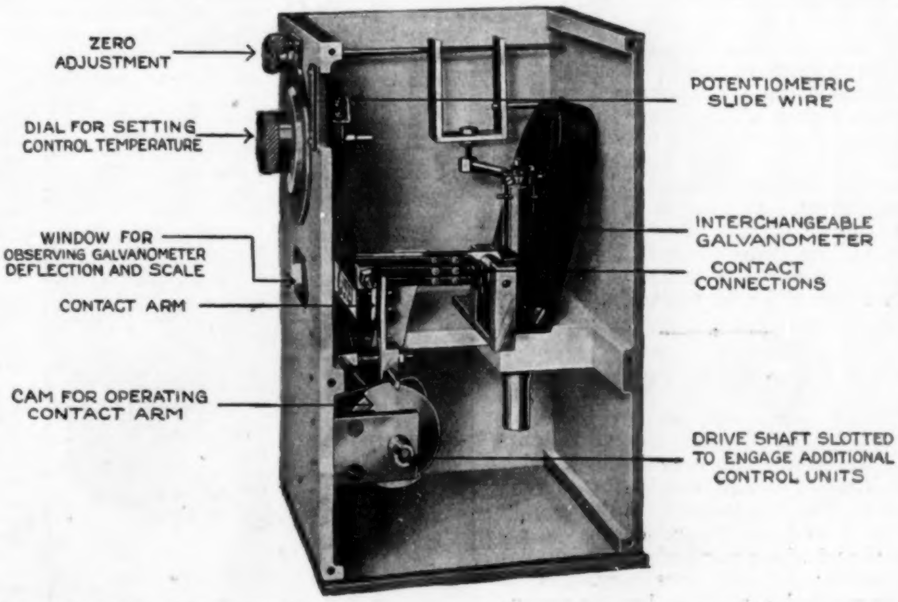
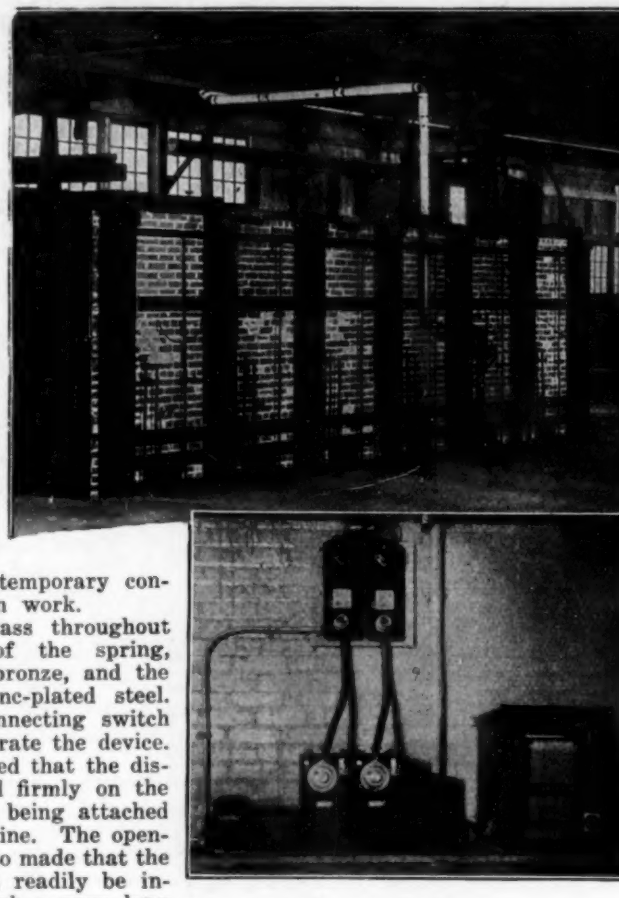


Fig. 2—Interior View of Automatic Temperature Control

The various parts of the device are here shown. The galvanometer is deflected according to temperature by a potentiometer circuit. The cam, revolved by the motor (not shown, see Fig. 1) moves a contact arm into a position determined by the galvanometer pointer deflection. A circuit closing arm then moves in and completes the circuit for operating the control valve or switch.

Fig. 3—Furnace Controlled by Automatic Controller

The enlarged insert shows the controller with two control units for controlling two fuel valves and a recording pyrometer for recording furnace temperatures. On the furnace shown at the top the controller can be situated wherever a convenient location for it is found, preferably in some place where it can be conveniently seen by the operator.



the pointer and the pointer does not come in contact with any part carrying an auxiliary or outside voltage. The control unit and the reduction gear are each housed in a cast-aluminum box. The temperature dial on the control unit has a circumference of 12 in., providing a 12-in. temperature scale, making close reading and setting possible.

It is claimed by the makers that this control reduces labor costs by relieving the necessity of constant temperature readings and valve settings; that it produces a more perfect and uniform product because the heating can always be maintained within specified limits; that it increases production by making full output possible; and that it saves fuel by eliminating periods of excess heating and forcing after drops in temperature.

Safety Lamp Handle

Probably every industrial plant uses electric lamps on extension cords for some purpose or other. Such plants will undoubtedly be interested in a new safety handle for extension cord and drop lights recently placed on the market by the Industrial Products Co., of 1001 Chestnut St., Philadelphia, Pa.

This handle is made of insulating rubber. It will fit either a keyed or keyless socket. The rubber insulates a workman handling such a light around machinery and other metal construction where there is likelihood of shocks from lamps. It is also claimed that the rubber handle protects and increases the life of both bulbs and sockets, in addition to protecting from both water and acid corrosion.

Line Connector

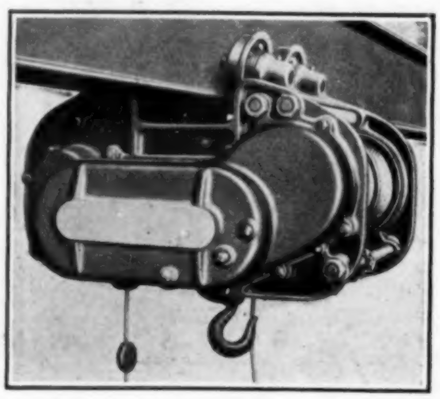
A new line connector has been designed specifically for use with lightning arresters, but may be used with any kind of device within its current rating. The connector is suitable only where occasional disconnecting is required and where particularly quick disconnecting is not necessary. It is recommended especially by the manufacturers for making temporary connections in construction work.

The clamp is of brass throughout with the exception of the spring, which is of phosphor bronze, and the two set screws of zinc-plated steel. Only a standard disconnecting switch hook is required to operate the device. The device is so designed that the disconnecting hook is held firmly on the connector when this is being attached to or removed from a line. The opening in the screw eye is so made that the disconnecting hook can readily be inserted in it, even though a very long switch hook pole is used.

This connector is made by the General Electric Co. and has been assigned Catalog No. 270,281. It has a current carrying capacity of 200 amperes and can be clamped on any wire from $\frac{3}{16}$ to $\frac{5}{8}$ in. in diameter. A $\frac{3}{16}$-in. hole is provided for soldering a lead to the connector.

Minimum Headroom Hoist

The photograph below shows the new model "Lo-Hed" hoist, made by the American Engineering Co., Philadelphia, Pa. This hoist, as do the others in the "Lo-Hed" line, permits operation with the minimum distance between the hook and the supporting rail. The new model is an electric monorail hoist and is built in small, light sizes for general utility. Capacities are $\frac{1}{2}$ ton and 1 ton. It travels on standard I-beams and can go around curves and through switches. Its construction is in general like the other hoists of this line, previously described in these columns. The low headroom feature gives clearance for loads, passing over other material or over machines. It also permits the higher piling of materials, so that storage space may be better utilized through its use.



Manufacturers' Latest Publications

Steere Engineering Co., Detroit, Mich.—Pamphlet 270. A leaflet on cooling coils for washer coolers, made of electro-sherardized material.

General Electric Co., Schenectady, N. Y.—Bulletin 45,124. A catalog entitled "Street Lighting Transformers," describing various types of constant current transformers, individual lamp series transformers, cutouts, transformer controls and protective devices. A table of transformer capacities is also included.

Celite Products Co., 11 Broadway, New York City—Bulletin B-8D. A booklet describing the use of Sil-O-Cel insulation on industrial furnaces and ovens, giving results obtained, methods of construction and information on application to special types of equipment.

Norton Co., Worcester, Mass.—A new booklet entitled "Factors Affecting Grinding Wheel Selection," which gives information enabling the user to select the proper wheel of Norton make to perform the desired work.

Alphons Custodis Chimney Construction Co., 95 Nassau St., New York—A new catalog on radial brick chimneys. This catalog covers the construction of such chimneys thoroughly, detailing the many types used for various purposes and also showing interesting pictures of actual chimneys. A special section of interest to process industry deals with chimneys subjected to acid gases.

Palo Co., 153 West 23rd St., New York—Leaflets on the Meker furnace and on microscopes, balances and other laboratory equipment.

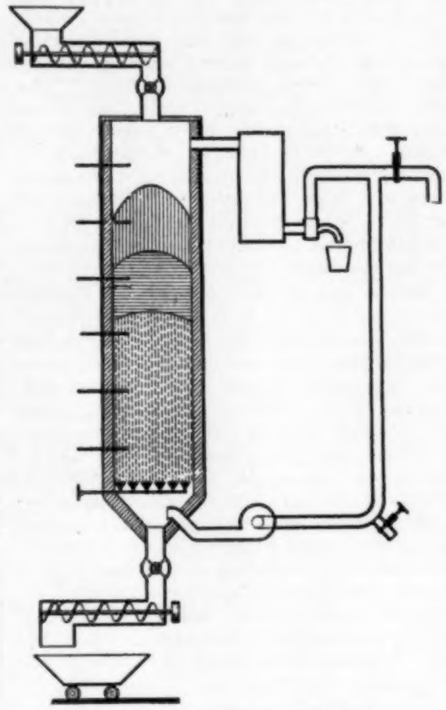
Review of Recent Patents

Wood Distillation Process

Perley S. Wilcox, of Kingsport, Tenn., has patented certain improvements of the Stafford process for wood distillation, which is used at the Kingsport plant of the Tennessee Eastman Co., a subsidiary of the Eastman Kodak Co.

The retort consists of a well-lagged vertical chamber into which wood in the form of chips is fed by means of a screw conveyor and valve. The wood, resting on a grate near the bottom, is set on fire and when it has reached the proper temperature all air supply is shut off and more wood is charged. The exothemic reaction of destructive distillation supplies all the heat required. The charge soon has three distinct layers: At the bottom, charcoal; above this, the main reaction zone; at the top, wood being preheated. By discharging charcoal and feeding fresh wood at a rate equivalent to that of pyrolysis, the relative position of the different zones is maintained nearly constant.

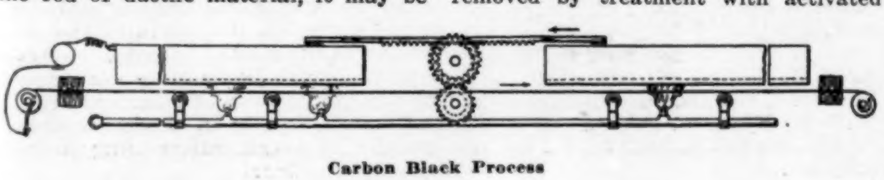
The volatile products of distillation pass to a condenser, where the liquids are separated. The fixed gases, containing as high as 40 per cent CO_2, are recirculated through the retort after being cooled to about 150 deg. F. As they pass up through the charcoal they serve to cool it and fill its pores with CO_2 so that it has little tendency to ignite when discharged. In the reaction zone, this circulation of gases makes possible effective control of the temperature, which should be below red heat but above 280 deg. C. Such control materially increases the yield of methanol and acetic acid. In the preheating zone the circulation insures effective heating and even makes it possible to use wood with 4 to 5 per cent moisture instead of less than 1 per cent. (1,510,730, assigned to Eastman Kodak Co., Oct. 7, 1924.)



Wood Distillation Process

Carbon Black

Attempts to increase the yield of carbon black by water-cooling the collecting plates have not been successful, as there seems to be a temperature below which deposition is unsatisfactory. George C. Lewis, of New Dorp, N. Y., has found it possible to increase the yield by cooling the flame before it reaches the collecting plate. This is accomplished by passing a metal rod or wire through the flame at such a rate that it does not accumulate an appreciable carbon deposit. Copper, nickel and alloys of these metals have been found very effective. By making the rod of ductile material, it may be wound and unwound from drums or passed over pulleys and the proper speed maintained by simple mechanism. This speed is determined by the length of the depositing surface, the number of flames, the type and size of flame, the raw material and the grade of carbon black required. Connecting the depositing plate and the cooling rod respectively to positive and negative terminals of an electrical circuit also increases the yield of carbon black. (1,510,485, assigned to Columbian Carbon Co., Williamsport, Pa., Oct. 7, 1924.)



Carbon Black Process

Butyl Alcohol and Acetone From Molasses

Guy C. Robinson, of Stamford, Conn., has discovered that all the sugars present in blackstrap molasses are fermented readily by organisms of the granulobacter type, but that the molasses is deficient in available nitrogen and contains certain toxic constituents that tend to retard fermentation. Finding that the ash from molasses prevented normal cell division of the culture, he conceived the idea of adding the molasses to a normally fermenting corn or cereal mash after the first stage of rapid cell division had reached its height. Other toxic principles can be removed by treatment with activated decolorizing carbon and molasses so treated yields a more rapid fermentation accompanied by better yields of neutral volatile products. (1,510,526, assigned to Atlas Powder Co., Wilmington, Del., Oct. 7, 1924.)

Glass for Insulators

A glass which has very high insulating quality, low coefficient of expansion and great stability is described by Fred M. Locke, of Victor, N. Y., as having the following composition:

	Per Cent		Per Cent
SiO_2	78.73	Na_2O	4.24
CaO	1.33	K_2O	0.62
Al_2O_3 and FeO	0.86	Mn	trace
MgO	trace	B_2O_3	14.22

The expansion coefficient of this glass is approximately 0.0000032. (1,510,521, Oct. 7, 1924.)

Coking Coal-Tar Pitch

Ray P. Perry, of Upper Montclair, N. J., overcomes the tendency of coal-tar pitch to foam during retorting, by forming the pitch in a still through which a stream of inert gas is constantly recirculated. Nitrogen, carbon monoxide and carbon dioxide have been found to be suitable. In this way pitch may be obtained that has a melting point of 450 deg. F. or over and it has been determined by repeated trials that when such pitch is coked no objectionable foaming takes place. The coke is found without great swelling, so that the coking still can be charged nearly to capacity. (1,511,192, assigned to The Barrett Co., Oct. 7, 1924.)

Cerium Oxide as Opacifier for Enamels

Cerium oxide, made from the residues of an incandescent gas-mantle plant, may be used as a tin-oxide substitute in enamel compositions, according to Hugh S. Cooper, of Cleveland, Ohio. The oxide may be used alone, in admixture with other rare-earth oxides present in the residues or in conjunction with known opacifiers, as tin oxide, sodium metantimonate and zirconium oxide. Cerium oxide can be used with high-silica frits where such opacifiers as zirconium oxide give poor results. (1,510,829, assigned to Kemet Laboratories Co., Cleveland, Oct. 7, 1924.)

Purifying Viscose

Viscose solutions may be purified before spinning by agitating with an organic liquid that does not dissolve viscose: 100 kg. viscose is emulsified in a mixing machine with 10 kg. paraffine oil; the emulsion is then centrifuged and the separated purified viscose spun as usual. The impurities that would tend to stop up the spinning openings are removed by this treatment. (1,510,810, Jacob R. N. Van Kregten, assignor to Naamlooze Vennootschap Nederlandsche Kunstzijdefabriek, Arnhem, Netherlands, Oct. 7, 1924.)

Important Technical Articles in Foreign Literature

"Electric Fusing of Quartz by the Vacuum-Compression Process." *Hugo Helberger.* A method of fusing quartz in a Helberger furnace, using crucibles of SiC. Air bubbles in the product are avoided by evacuating the fusion chamber, and when the quartz is well fused filling the chamber with a gas under pressure. Optical irregularities are minimized by selecting the most perfect quartz obtainable (from Brazil and from the Gotthard region). *Z. für Elektrochem.*, September, 1924, p. 435.

"Chemical and Technical Uses of the Electric Motor as a Source of Power." *W. Meysahn.* Advantages of single electric motors for small power requirements are discussed. They include lowered construction costs, economy in power and in lubricants, ease of repair without extensive shutdowns, and simplification of the transmission problem. *Chem.-Ztg.*, Sept. 18, 1924, pp. 665-6.

"Obtaining Chromium by the Electrolytic Method." *J. Sigrist, P. Winkler* and *M. Wantz.* The best yield is obtained from a solution made by dissolving in hot water enough $Cr_2(SO_4)_3$ to give 161 grams of metallic Cr per liter. The optimum current density is about 160 amp. per sq.dm. The p_H must be low enough to permit a satisfactory deposit and high enough to avoid formation of a cathode mud of $Cr(OH)_3$. Chromic acid solutions give a better deposit but lower yields than solutions of Cr salts. *Helvetica Chim. Acta*, October, 1924, pp. 968-72.

"A New Nitrating Process Using Nitrogen Oxides From Air or Ammonia." *Alfred Schaarschmidt.* Aromatic hydrocarbons form equimolar addition compounds with metal chlorides (for example, $AlCl_3$ or $FeCl_3$), in which state they react like olefines with N_2O_4. The product reacts with H_2O to form a mononitro hydrocarbon and HNO_3. The products recoverable from the aqueous solution include $Al(OH)_3$, NH_4NO_3 and NH_4Cl. *Chem.-Ztg.*, Oct. 7, 1924, p. 725.

"Advances in the Glue and Gelatine Industry." *H. Stadlinger.* Sets forth the advantages of the "pearl" form for glue or gelatine. The pearls are made by dripping glue or gelatine solutions through fine orifices into suitable media. A wide variation in size of the pearls is possible. The chief advantage is in the greatly increased rate of swelling in water as compared to sheets. The pearls are more convenient to transport and use than flake or powder. Another advantage is rapid gelatinization, effected by cooling the medium. *Z. für angewandte Chem.*, Aug. 21, 1924, pp. 642-4.

"Reports on the Progress of Naphthology During 1923." A comprehensive review by specialists covering heavy distillates, lubricants, special products, chemistry, cracking, refineries, hydrogenation and statistics. A bibliography of books is also included. *Journal Institution of Petroleum Technologists*, September, 1924, pp. 607-686.

New Publications

"Popular Research Narratives" is the title under which the Engineering Foundation has collected in book form fifty of its leaflet "Research Narratives." To promote public interest in research invention and discovery the Engineering Foundation, New York, N. Y., began in 1921 the semi-monthly printing of very short stories in lay language from original sources. The first fifty of these have now been brought together in book form. They cover a wide range of inventions authoritatively, as the data have been obtained from the inventors themselves or from those in close contact with the developments. They make most interesting reading.

"Flat Glass," by *Arthur E. Fowle*, vice-president and treasurer, Libbey-Owens Sheet Glass Co., presents in most informative and entertaining fashion the fascinating story of the American window glass industry. Beginning with early references to the use of glass for windows, the development of the manufacturing methods is traced from crown glass, through the hand cylinder and machine cylinder processes to the latest machines which produce a really flat sheet by drawing it flat and keeping it flat from start to finish. Excellent illustrations, many in colors, assist materially in the exposition. The book is being distributed by the Libbey-Owens Sheet Glass Co., Toledo, Ohio.

"Klorkalciums Användning Vid Cement-och Betongarbeten Sasom Skyddsmedel Mot Köld." By *Rikard V. Frost.* Published by Statents Provningsanstalt, Stockholm, Sweden.

"Undersökningar av Ett Svenskt Högvärdigt Cement Och I Samband Därmed Utförda Betongprovningar." By *Rikard V. Frost.* Published by Statens Provningsanstalt, Stockholm, Sweden.

"Technical Books of 1923. A Selection." This book has been compiled by *Donald Hendry*, head of the applied science reference department of Pratt Institute Free Library, Brooklyn, N. Y.

"The Melting Point of Coal Ash." By *F. S. Sinnatt, N. Simpkin* and *A. B. Owles.* Published by H. F. & G. Witherby, 326 High Holborn, London, W. C., England. Price 2s.

The Mellon Institute of Industrial Research of the University of Pennsylvania has issued an attractive book on "Industrial Fellowships." There are chapters on officers of administration; history of the industrial fellowship system; general principles of the industrial fellowship system; outline of industrial fellowship procedure; association fellowships; scope and spirit of industrial research and industrial fellowship agreement.

U. S. Geological Survey Publications

"Quicksilver in 1923." By *Clyde P. Ross*, with a supplementary bibliography by *Isabel P. Evans.*

"Zinc in 1923." By *C. E. Siebenthal* and *A. Stoll.*

"Tin in 1923." By *Bertrand Leroy Johnson.*

"Bismuth, Selenium and Tellurium in 1923." By *Victor C. Heikes.*

"Fuel Briquets in 1923." By *W. F. McKenney.*

"Slate in 1923." By *G. F. Loughlin* and *A. T. Coons.*

"Gypsum in 1923." By *K. W. Cottrell.*

"Peat in 1923." By *K. W. Cottrell.*

"Clay in 1923." By *Jefferson Middleton.*

"Barytes and Barium Products in 1923." By *C. E. Siebanthal* and *E. R. Phillips.*

"Carbon Black Produced From Natural Gas in 1923." By *G. B. Richardson.*

"Graphite in 1923." By *Jefferson Middleton.*

"Fullers Earth in 1923." By *Jefferson Middleton.*

"Mica in 1923." By *B. H. Stoddard.*

"Coal in 1922." By *F. G. Tryon* and *Sydney A. Hale.*

Imperial Mineral Resources Bureau Publications

"Copper Statistics, 1920-1922." Price 2s 6d.

"Coal, Coke and Byproducts. Statistics, 1920-1922." Price 7s. 6d.

"Aluminum (Including Bauxite and Cryolite). Statistics, 1920-1922." Price 1s. 3d. All the above can be purchased from H. M. Stationery Office, Adastral House, Kingsway, London, W.C.2, England.

Books Received

Liquid Fuels

LES COMBUSTIBLES LIQUIDES ET LE PROBLÈME DU CARBURANT NATIONAL (Liquid Fuels and the Problem of National Fuel.) By *M. Aubert*, chef de travaux, pratiques a la Faculté des Sciences de Paris. Preface by *Paul Sabatier.* 368 pages, illustrated. Gauthier-Villars & Cie., Paris. Price, 24 francs.

Liquid fuels derived from petroleum form the main subject for discussion in this book, physical, optical and thermodynamic properties, combustion phenomena and preparation from natural sources being treated in detail. Under the heading "Artificial Liquid Fuels," cracking processes, benzene and products from coal tar, lignite and shale are covered. Considering the national fuel problem as affecting France, the importance of industrial alcohol is pointed out and a summary of methods for making anhydrous alcohol is given.

Bauxite in India

BAUXITE AND ALUMINOUS LATERITE OCCURRENCES OF INDIA. By *C. S. Fox*, assistant superintendent, Geological Survey of India. 287 pages, illustrated. Published as Vol. XLIX, Part I, Memoirs of the Geological Survey of India, Calcutta. Price, 5 rupees, 8 annas.

While a large part of this book is devoted to a detailed description of individual bauxite deposits throughout India, the introductory chapter contains valuable data on the origin of the deposits and the uses of bauxite. A subsequent chapter covers quite completely the bauxite deposits of other countries, and there is finally an annotated bibliography, 66 pages, entries being alphabetical by author.

An Introduction to Colloids

COLLOID CHEMISTRY: An Introduction, With Some Practical Applications. By *Jerome Alexander*, consulting chemist and chemical engineer. Second edition, 200 pages, illustrated. D. Van Nostrand Co., New York. Price, $2.

Favorable reception accorded the first edition of this book has led the author to enlarge both the theoretical and technical sections. A large number of new practical applications have been introduced and the effort has been made to develop the subject in a simple, coherent and interesting manner, using as far as possible non-technical language and homely illustrations. In this the author has succeeded.

Readers' Views

Electrochemical Manufacture of Gold Leaf

To the Editor of Chem. & Met.:

Sir—During an absence from Philadelphia several copies of *Chem. & Met.* accumulated unread, and I have just seen an editorial in the June 30 issue on "Electrochemistry and the Manufacture of Gold Leaf," which recalls an early investigation of mine along the same lines. In looking over the contents of an old file on the subject I found included a paper on "Transparent Films of Metal," from *Chem. & Met.* of March 29, 1922, in which there is extended mention of my experiments in 1877—a tribute I had forgotten. I also found copies of a United States patent granted to me in 1877 for the manufacture of "Gold Leaf, Silver Leaf and Other Metallic Leaf" by electrochemical methods; and a letter from Professor Eggleston, of the School of Mines, Columbia College, N. Y., dated Feb. 21, 1876, thanking me for a large transparent gold film mounted on a glass slide, for lantern projection. Prof. S. P. Langley used some of the metal foil produced by my electrodeposition method in his early work with the bolometer—an electric instrument for measuring minute quantities of radiant heat.

The earliest publication of my original investigation may be found in a brief communication to the American Philosophical Society at its meeting held Feb. 16, 1877, by the chief assayer of the Mint, W. E. DuBois, a member of the society, recorded in *Proceedings*, vol. 99. Subsequently the late Patterson DuBois (son of W. E. DuBois) read a more extended paper on the same subject before the same society April 5, 1895, printed in its *Proceedings*, vol. 34.

The chief difficulty I found in obtaining gold leaf by electrodeposition was that, when drying, it tended to adhere tenaciously to any substance with which it was in contact. I was far more interested in producing and studying extremely thin metal films than in trying to commercialize the production of gold leaf by electrolytic means.

ALEX. E. OUTERBRIDGE, JR.

U. S. Patents Issued October 21, 1924

Plastic Composition. Carl D. Hocker, East Orange, N. J., assignor to Western Electric Co., Inc., New York, N. Y.—1,512,024.

Manufacture of Tire Casings. Ernest Hopkinson, New York, N. Y.—1,512,094.

Method and Apparatus for Rubberizing Filamentary Material. Ernest Hopkinson, New York, N. Y., and Kenneth B. Cook, East Orange, N. J., assignors to Morgan & Wright, Detroit, Mich.—1,512,095.

Process and Apparatus for Manufacturing Weftless Fabric. Ernest Hopkinson, New York, N. Y.—1,512,096.

Tire-Building Apparatus. Curt Kuentzel, Akron, O., assignor to the B. F. Goodrich Co., New York, N. Y.—1,512,108.

Process of Forming Abrading Articles. Paul Keever, West Chester, Pa., assignor to White Heat Products Co., West Chester, Pa.—1,512,177.

Method for Use in Soap-Powder Making. Judson A. De Cew, Mount Vernon, N. Y., assignor to Process Engineers, Inc., New York, N. Y.—1,512,211.

Paper-Sizing Composition and Method of Making the Same. Judson A. De Cew, Mount Vernon, N. Y., assignor to Process Engineers, Inc., New York. N. Y.—1,512,212.

Paper-Sizing Composition. Judson A. De Cew, Mount Vernon, N. Y., assignor to Process Engineers, Inc., New York, N. Y.—1,512,213.

Feeding Device for Glass Furnaces. Forrest L. Hitchcock, Indianapolis, Ind., assignor to the Marietta Manufacturing Co., Indianapolis, Ind.—1,512,223.

Process of Speeding Chemical Reactions. Herman B. Kipper, Musekgon, Mich.—1,512,225.

Process of Making Hydrochloric Acid and Sodium Sulphate. Herman B. Kipper, Muskegon, Mich.—1,512,226.

Process of and Apparatus for Cracking or Converting Oils. Otto P. Amend, New York, N. Y.—1,512,263.

Process of Converting Oils. Otto P. Amend, New York, N. Y.—1,512,264.

Process for the Separation and Purification of Argon and Other Rare Gases of the Atmosphere. Emile Augustin Barbet, Paris, France.—1,512,268.

Reduction of Oxides. Louis Burgess, Westfield, N. J., assignor, by mesne assignments, to himself and Maurice Barnett.—1,512,271.

Machinable Non-Magnetic High-Resistance Cast-Iron Alloy. Stanley Ernest Dawson, Davenport, Stockport, England, assignor, by mesne assignments, to Ferranti Meter and Transformer Manufacturing Co., Ltd., Toronto, Canada.—1,512,277.

Ozone Generator. Harry B. Hartman, Scottdale, Pa., assignor to Electric Water Sterilizer & Ozone Co., Scottdale, Pa.—1,512,285.

Temporary Binder for Ceramic Bodies. Joseph A. Nagle, Columbus, O., assignor to the Jeffrey-Dewitt Co., Detroit, Mich.—1,512,299.

Apparatus for Centrifugal Concentration. Orrin B. Peck, Jr., Los Angeles, Calif.—1,512,305.

Process of Extracting Sulphur From Ore. William P. Thornton, Chicago, Ill.—1,512,320.

Filtering Process and Apparatus. Justin F. Wait, Buffalo, N. Y.—1,512,321.

Magnetic Separator. Laul Lorang, Metz, France.—1,512,344.

Briquetting Process. W. A. Lorenz, Hartford, Conn.—1,512,345.

Gas and Oil Separator. Bertram Neill, Norwalk, Calif.—1,512,358.

Process of Coating Material. William H. Sommer, Peoria, Ill.—1,512,371.

Glass-Forming Machine. Leonard D. Soubier, Toledo, O., assignor to the Owens Bottle Co., Toledo, O.—1,512,372.

Glass Feeder. Leonard D. Soubier, Toledo, O., assignor to the Owens Bottle Co., Toledo, O.—1,512,373-74.

These patents have been selected from the latest available issue of the "Official Gazette" of the United States Patent Office because they appear to have pertinent interest for "Chem. & Met." readers. They will be studied later by "Chem. & Met's" staff, and those which, in our judgment, are most worthy, will be published in abstract.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Automatic Glass-Feeding Machine. Thomas William Warren, Montreal, Quebec, Canada.—1,512,383.

Fluid-Pressure Indicator. Herbert Courtenay Widlake, Plymouth, England.—1,512,385.

Glass-Cutting Apparatus. Enoch T. Ferngren, Toledo, O., assignor to the Owens Bottle Co., Toledo, O.—1,512,412.

Wood-Preserving Emulsion. John Foley, Wayne, Pa.—1,512,414.

Manufacture of Aluminum Chloride. George W. Gray, New York, N. Y., assignor to the Texas Co., New York, N. Y.—1,512,419.

Manufacture of Treating Materials Containing Aluminum Chloride. Frank W. Hall, Port Arthur, Tex., assignor to the Texas Co., New York, N. Y.—1,512,420.

Fuel-Producing Process and Product. Walter Edwin Trent, Washington, D. C.—1,512,427.

Process of Making Arsenic Compounds. Norman Underwood, Oakton, Va.—1,512,432.

Method for Desiccation. Walter L. Fleisher, New York, N. Y.—1,512,461.

Al, Si or Ca, or Alloys. T. R. Haglund, Stockholm, Sweden.—1,512,462.

Methods for Grinding Products Containing a High Percentage of Grease, Such as Almonds, Coffee Beans, Cacao Beans and the Like. Werner Iff, Flawil, Switzerland, assignor to the Firm Buhler Brothers.—1,512,466.

Electric Accumulator. Adolfo Pouchain, Turin, Italy.—1,512,485.

Evaporating Pan. Arthur D. Stevens and Naulbert A. Gilbert, Jacksonville, Fla.—1,512,505.

Producing Vessels of Quartz or Similar Material difficult to Fuse and Impermeable for Gases. Zacharias von Hirschberg, Berlin-Pankow, Germany.—1,512,511.

Method of and Apparatus for Protecting Metal Tanks Against Corrosion. Ronald Van Auken Mills, Sandy Spring, Md., assignor to Peter Q. Nyce, Washington, D. C.—1,512,557.

Method and Apparatus for Delivering Viscous Glass. Oliver M. Tucker and William Reeves, Columbus, O.—1,512,566.

Process for the Distillation of Bituminous Coal. Frederick Charles Blythe, Southsea, England.—1,512,577.

Combustion System for Hot-Blast Stoves. Ambrose N. Diehl, Duquesne, Pa.—1,412,583.

Heating Furnace. James H. Knapp, Los Angeles, Calif.—1,512,607.

Amorphous Saccharine Powder and Process of Making Same. George Washington, Brooklyn, N. Y.—1,512,730.

Food Product and Process of Making Same. George Washington, Brooklyn, N. Y.—1,512,731.

Process of Utilizing Arsenious Byproducts. Ernest W. Westcott, Niagara Falls, N. Y., assignor, by mesne assignments, to Metallurgical Development Corp., Boston, Mass.—1,512,733.

Process of Purifying Arsenious Chloride. Ernest W. Westcott, Niagara Falls, N. Y., assignor, by mesne assignments, to Metallurgical Development Corp., Boston, Mass.—1,512,734.

Process of Producing Non-Inflammable Celluloid-Like Products. Alfons Fausten, Cologne-on-the-Rhine, Germany, assignor to Deutsche Springstoff - Actien - Gesellschaft in Hamburg, Hamburg, Germany.—1,512,751.

Machine for Removing the Pulp or Core in Coconuts and the Like. Bruno Muller, Berlin-Neukolln, Germany.—1,512,790.

Thoria-Crucible Production. Henry Kneeland Richardson, Newark, and Theodore MacLean Switz, East Orange, N. J., assignors to Westinghouse Lamp Co., Penn.—1,512,801.

Manufacture of Gold Leaf. Friedrich Demel, Twickenham, England, assignor of one-half to Richard Tindall Leighton, Hove, Sussex, England.—1,512,825.

Process for the Production of Sulphuric Acid. Theodor Schmiedel, Nuremberg-Doos, and Hans Klencke, Frankfort-on-the-Main, Germany.—1,512,863.

Manufacture of Zinc Oxide. George S. Brooks, Gary, Ind.—1,512,873.

Quantitative Determination of Hydrogen Sulphide in Illuminating and Other Gas. Walter H. Fulweiler, Wallingford, Pa., assignor to the U. G. I. Contracting Co., Philadelphia, Pa.—1,512,893.

Process of Obtaining Solids of Predetermined Degrees of Dispersion. Volkmar Kohlschutter, Berne, Switzerland.—1,512,897.

News of the Industry

Summary of the Week

The German Dye Cartel has secured control of extensive deposits of coal suited for production of coal tars.

Tetra-ethyl lead reported to be responsible for fatalities which occurred at New Jersey plant.

Official returns indicate an increase in imports of chemicals during September, but exports fell below the total for August.

About one-half of dye producers furnish data on prices and sales of dyes for first 9 months of 1924.

Chemical Foundation has filed voluminous brief in reply to the government appeal for the restoration of German patents.

Reports from Germany state that Chinese revolution has curtailed demand for indigo and caused a large plant at Ludwigshafen to close.

Advancing tendency in metal markets is resulting in higher prices for metal salts.

Bureau of Standards and Portland Cement Association plan to enlarge research work on cement.

Tetra-Ethyl Lead Figures in Fatalities in New Jersey Plant

In Spite of Precautions, Manufacture at Bayway Results in Deaths of Five and Injury to Many Workmen

THE commercial production of tetra-ethyl lead, the anti-knock constituent of "ethyl gas," received a serious setback last week as the result of poisoning that proved fatal to five and more or less severely affected about thirty other employees of the small-scale plant of the Standard Oil Co. at Bayway, N. J. The poison has a queer physiological effect largely confined to the brain and nervous system of the victim. New York and local newspapers gave a great deal of sensational publicity to the unfortunate occurrence, emphasizing particularly the mysterious action of what was generally referred to as an "insanity gas."

According to a statement issued by the New York office of the company, the poisoning occurred in spite of strictest medical and chemical supervision of the manufacturing operations. Shortly after Aug. 1, and following the formation of a new company representing the interests of both the Standard Oil Co. of New Jersey and the General Motors Research Corporation, the development department of the former company began to test out the commercial synthesis of tetra-ethyl lead on a larger-than-laboratory scale. Under the supervision of Dr. C. O. Johns, director of chemical research, a temporary plant having a capacity of approximately 100 gal. per day was installed in one of the company's development buildings located at the Bayway refinery near Elizabeth, N. J. It was planned to use these quarters for about 6 months, during which period the details of manufacture would be sufficiently worked out to warrant construction of a permanent building equipped for commercial production. This plant would probably have been erected at Chicago had the experimental work at Bayway succeeded in solving some of the unusual manufacturing problems. It is understood that the latter included, among other problems, the substitution of ethyl chloride for the bromide compound that had previously been employed in the commercial synthesis. This gave rise to some of the earlier newspaper reports that ethyl chloride, the anæsthetizing effects of which are already well known, was the cause of the poisoning. Later developments, however, seemed to point to the lead compound, although definite physiological determination of this fact is still wanting.

Recognizing the fact that the commercial manufacture involved certain dangers, the development department is reported to have taken every conceivable precaution. In addition to close medical supervision by the plant physicians at Bayway, the company employed as a special medical consultant, Dr. J. Gilman Thompson, generally recognized as one of the foremost authorities on occupational diseases. Frequent examinations were required for all of the forty-five employees of this department and only those in good physical condition were permitted to work. All symptoms of gas poisoning were carefully watched for and when reported the men were laid off on pay and given medical attention. Other precautions consisted of the required use of gas masks, rubber gloves, boots and other protective clothing, since it was recognized that physical contact with the tetra-ethyl lead liquid or vapors might result in poisoning.

Du Pont Reports Experience With Lead Compound

In a recent interview, Irenée du Pont, president of E. I. du Pont de Nemours & Co., declared that in earlier experimental stages before commercial production of tetra-ethyl lead was attained his company met with some fatal accidents, but these difficulities have since been solved. Mr. du Pont said:

"The du Pont company, during the experimental period, experienced much trouble with men becoming poisoned, even to the extent of fatalities. During the past year of production, when more than 100 men have been employed continuously, the difficulty has diminished steadily. In the past several months, under full production, only slight difficulties have been encountered. Experience has taught the necessary protection, both in plant and medical care.

"We find that workmen cumulatively poisoned by this material invariably indicate it in the incipient stages, before any harm is done, by a marked sympton. Doctors in the employ of the company continually make tests on workers engaged in this process."

Investigations Started

On Saturday, Oct. 25, five of the plant employees who had been under medical care became seriously ill and were transferred to the Reconstruction Hospital in New York City, along with three others who had been affected. The first death, that of Ernest Oelgert, was reported that day. On Monday the second victim, Walter Dymock, died

violently insane, and this was followed under similar circumstances by the death Tuesday of William McSweeney, who had been taken to the hospital in a straitjacket because of his deranged and violent condition. The cases of two other workmen were reported critical on Tuesday and at that time twelve additional employees were taken to the hospital to be placed under observation. On Wednesday William Kresge, who was one of the first to be taken to the hospital, succumbed to the poisoning. Eleven more of the workers were brought to the New York hospital on Wednesday and four were confined at Elizabeth. The fifth death, that of Herbert Fuson, occurred on Thursday. Announcement was made at that time that the remainder of the cases were of a less serious nature and further fatalities were not expected.

In all, thirty-five of the forty-five employees were affected, five have died and thirty-one have shown symptoms that warranted medical care. Considerable alarm was experienced at first because of the progressive nature of the poisoning and the fact that no effective antidote appeared to have been discovered. It was not until after the fourth death that physicians reported that the intravenous injection of sodium thiosulphate had proved successful in eliminating the lead, while sodium bromide in large doses acted as a sedative where other remedies had failed.

The plant at Bayway has been closed since the first serious illness developed and the company announced that it would not be opened until investigation had revealed the cause of the poisoning and shown how it could be prevented. The civil authorities, represented by A. J. David, prosecutor of Union County, in which the plant was located, and Dr. A. F. McBride, Commissioner of Labor for the State of New Jersey, have initiated separate investigations to ascertain the possible responsibility of the company either through criminal negligence or the violation of state laws governing ventilation and providing for healthful working conditions. Representatives of the United States Bureau of Mines, who for some time past have been studying the use of treated motor fuels, are expected to co-operate in the investigations begun by the state and local officials.

New York Bars Ethyl Gas

Health authorities of New York City, by a resolution passed on Oct. 30, forbid the use of gasoline "to which compounds containing lead or other deleterious substances have been added." This action followed representation made by Prof. Yandell Henderson of Yale and others that the use of motor fuels containing tetra-ethyl lead constituted a menace to the public health. The Boards of Health in New Jersey and other outlying districts were urged to take similar action.

It was stated by the manufacturers of the product that tetra-ethyl lead, greatly diluted, was being used in gasoline dispensed from more than 10,000 filling stations and garages and that no ill effects had ever been reported. Before the product was put on the market thorough tests of the possible danger in its use were made by the company and by responsible medical authorities.

Ethyl Gasoline Does Not Increase the Hazard of Auto Exhaust

Bureau of Mines Finds No Lead Poisoning After Exhaustive Tests on More Than One Hundred Animals

RESULTS of 10 months investigation by the technical staff of the United States Bureau of Mines at its Pittsburgh station show that there is no unusual hazard connected with the exhaust gases from automobiles using ethyl gasoline, which is the commercial motor fuel containing one part tetra-ethyl lead to a thousand parts of ordinary gasoline. Preliminary results of these tests were made public by the bureau on Oct. 31 to correct the erroneous impression that the poisoning in the Bayway laboratories was due to ethyl gasoline. The bureau emphasizes the fact that the deaths were incurred in the manufacture of the concentrated tetra-ethyl lead, which is not in itself a motor fuel.

The statement points to three hazards connected with tetra-ethyl lead—viz., 1. That in manufacturing and handling the concentrated lead compound. 2. That in distributing this compound and mixing it with gasoline. 3. That in the use of ethyl gasoline in automobiles. The first two hazards, although of lesser immediate importance to the general public, are also being investigated, but judging from newspaper accounts and the action of certain health authorities, present interest centers in the actual dangers from the automobile exhaust. It is on this phase of the subject that the bureau's statement throws most light, as is indicated by the following paragraphs from the official report:

How It Was Tested Out

"The plan of investigation was that of exposing various animals (pigeons, guinea pigs, rabbits, dogs and monkeys, more than 100 in all) to a definite concentration of exhaust gas from an engine using ethyl gasoline. The concentration of exhaust gas in air used was that which, when coming from the average automobile, would be 4 parts of CO in 10,000 parts of air; this concentration would be allowable for but a period of 1 hour's exposure from the standpoint of carbon monoxide. The concentration of exhaust gas in air was such as to exceed that known to exist in ordinary traffic of a city street. The carburetor was then adjusted so that the carbon monoxide content of the exhaust gas from the engine used was less than one-half that found in the average automobile exhaust gases.

"The animals were divided into three representative groups. The first two groups were exposed for periods of 3 and 6 hours respectively and the third group not exposed but used as controls. The animals were thus daily exposed for 3 and 6 hours over a total period of approximately 8 months to a known concentration of exhaust gas. These exposures were such that the lead content of the air breathed by the animals was similiar to that which would result when exhaust gases of an average automobile using ethyl gasoline are diluted so as to contain about 4 parts of carbon monoxide to 10,000 parts of air (the permissible exposure for 1 hour from the standpoint of carbon monoxide poisoning). This was a considerably higher concentration of exhaust gas than would ordinarily occur.

"The animals were observed throughout the entire test period for symptoms of lead poisoning, as colic, paralysis, loss of appetite and loss of weight. Also, a careful examination of the blood was made for characteristic signs of lead poisoning. At various times animals were killed and the entire tissues examined for effects of lead and analyzed for stored-up lead.

"After a period of approximately 8 months daily exposure to the above conditions there was no indication of lead poisoning. The animals continued to grow and mature at a normal rate. One of the dogs gave birth to five puppies. These were continued on test with the mother and in the course of the test matured normally. The absence of lead poisoning may be due to the small amount of lead present in the exhaust gas air mixture. Furthermore, observations made on men showed that most of the lead in exhaust gases coming from ethyl gasoline when inhaled is again exhaled.

"The investigation carried out indicates that the danger of lead accumulation in the streets through the discharging of scale from automobile motors is seemingly remote."

American Cells for Chlorine Manufacture in Germany

While plans looking to the exportation of American chlorine to Germany have fallen through, the Germans are buying American cells for chlorine manufacture. The superiority of American cells has been recognized abroad for some years, but actual orders seem to have been a trade promotion effort on the part of the Department of Commerce.

Before the war Germany's production of chlorine did not meet the country's requirements. This led to efforts to produce hydrochloric acid synthetically. While the synthetic acid has some special value, in that it is free from arsenic, it apparently is not necessary to resort to this process under present conditions, especially as there now is a commercial production resulting from the treatment of potassium chloride from Alsace mines with sulphuric acid. This with regularly produced chlorine seems to be meeting existing requirements.

New York Electrochemists to Meet

The New York section of the American Electrochemical Society will hold a meeting Friday evening at 6.30 at Keen's Chop House, 72 West 36th St. Among the speakers will be William Blum and Charles H. Proctor, of the Bureau of Standards. Electroplating will be the subject under discussion.

Washington News

Joint Research on Cement Will Be Extended

Further plans for the co-operative study of the physical-chemical properties of portland cement by the National Bureau of Standards and the Portland Cement Association include the following projects:

1. A study of cement clinker made from pure compounds and from pure compounds with admixture of the impurities found in natural materials.
2. Petrographic studies to determine the optical characteristics of cement mineral constituents and the quantitative petrographic analysis of clinker.
3. A study of the hydration of cement in all its phases.
4. The crystalloidal behavior of silicic acid.

Thus far the work has included principally the development, construction and standardization of equipment and methods of testing; but results of industrial significance will doubtless be forthcoming shortly. It is hoped that the studies can be extended into other fields beyond those already projected. This work will continue and extend the bureau's studies, which for several years have been under the direction of P. H. Bates; Dr. R. H. Bogue, formerly at Lafayette College, will be directly in charge of the association's group of workers who are stationed at the bureau.

Creosote Oil Big Factor in Wood Preserving in Germany

Trade Commissioner W. T. Dougherty at Berlin in reporting on the wood-preserving industry of Germany says it has become progressively dependent on creosote oil, derived there exclusively from coal tar, and applied by the so-called Rueping process, which was first introduced in 1903. Normal consumption of oil for wood-preserving in Germany is estimated unofficially at about 200,000 tons annually, 80 per cent of local production being accounted for by two leading manufacturers, Ruetgerswerke Aktien Gesellschaft, of Berlin, and Verkaufsvereinigung für Teererzeugnisse, of Essen. The latter is furthermore associated with the Ruetgerswerke, and combines with it the so-called Gesellschaft für Teerverwertung, of Duisburg.

Belgian Metallurgical and Glass Industries Depressed

According to reports from Commercial Attaché Cross, negotiation of a commercial treaty between Belgium and France has begun. The Belgian metallurgical and glass industries are depressed, and heavy importation of British and German coal has deterred the Belgian coal industry. The German loan was oversubscribed. A large loan is expected within a few months, to cover interior and colonial needs. Money continues tight, and the National Association reparation loan was subscribed only to 160 million francs of the 2 billion asked for. Wage increases now under consideration by the government will cost 3 million francs and require new taxes to balance the budget. The Rumanian Government has agreed to recognize all bonds acquired by Belgian nationals during the war. Poor Belgian crop yields indicate larger purchases of foreign foodstuffs.

Requests for Lower Freight Rates to Be Decided Today

The following subjects have been docketed for consideration before the Standing Rate Committee of the Southern Freight Association at Atlanta, Ga., on Monday, Nov. 3:

Denatured Alcohol—Shippers propose that the carload rate on denatured alcohol from New Orleans, La., to Atlanta, Ga., be reduced from 60c. per 100 lb. to 44c. per 100 lb.

Bark and Tanning Extracts—Proposal initiated by shippers, rates suggested by carriers: bark and tanning extract from Chattanooga, Tenn., to Johnson City, Tenn., Middlesboro, Ky., and Big Stone, Va.

	In Cents Per 100 Lb.			
	Present		Proposed	
To	Liquid	Dry	Liquid	Dry
Johnson City, Tenn......	21½	33	21½	21½
Big Stone Gap, Va......	31	42½	25	25
Middlesboro, Ky........	28½	39½	18½	18½

Proposed rates are in line with rates from and to other points, distance considered.

Silicate of Soda—Proposal initiated by shippers; rates suggested by carriers: Silicate of soda carloads from Philadelphia, Pa., and Chester, Pa., and Camden, N. J., to High Point, N. C. Present rate 45c.; proposed, 38c. per 100 lb. made with relation to present rate to Greensboro, N. C.

Menthol Prices Bring Protest From Consumers

Apparent stabilization of menthol at the high price levels that have prevailed since the war is giving rise to an increasing volume of protest from American consumers. The Japanese producers apparently are not alarmed by the manufacture of the synthetic product or by the efforts being made to produce natural menthol in this country.

It is admitted by American consumers that synthetic menthol is not suitable for many important uses, but they are hopeful of securing relief through the success which is accompanying the work of the Department of Agriculture in its efforts to grow mint in this country which will have a high menthol content. For a long time this work was delayed through inability to secure seed from the Japanese plant. Supplies of the seed finally were received, however, and flourishing growths of the plant have been obtained in New York, Oregon and Indiana. Experimental tracts planted in North and South Carolina have not done so well. The menthol content is fully equal to that obtained by the plant in Japan. At the Department of Agriculture the belief is held that sufficient supplies of natural menthol can be produced in this country within a very short period to affect the price of the imported article.

This development is a counterpart of the successful efforts to produce chinawood oil in Florida. The existing tung oil groves are flourishing and steps now are being taken to extend them greatly.

France Is Large Consumer of Copper Sulphate

The total consumption of copper sulphate in France is estimated at from 60,000 to 70,000 tons annually and, according to estimates submitted to the government, the twenty or more factories in France are capable of producing 100,000 tons a year. Their actual output, however, apparently does not equal this, as considerable quantities are imported each year, according to a report received by the Department of Commerce.

The vine-growing region of southwest France is the most important center of consumption of sulphate of copper and apparently for that reason Bordeaux and vicinity was selected as the site for three factories. Of these the "Société Anonyme la Cornubia" is considered one of the most important in France. It employs about 200 workmen and its capacity of production is 30,000 tons annually. It is a French branch of an English company specializing in copper. The pure copper received in small grains from England is treated by sulphuric acid. The proportion of product obtained is about 75 per cent additional to the weight of the copper. The two other sulphate of copper factories in this region are the "Cuivre Electro Grammont" at Pauillac, and the "Société des Etablissements de Saint Gobain" at Marennes.

American Paper Requirements Exceed 8,000,000 Tons

American paper requirements have nearly quadrupled since 1899 and now exceed 8,000,000 tons a year, according to a report of the pulpwood paper and pulp situation just compiled by the Forest Service. The per capita consumption of paper in the United States is double that of any other country, and the entire consumption of more than 8,000,000 tons per year is greater than that of all other countries in the world combined.

Asbestos Production of Canada Gained in 1923

According to government statistics, asbestos production in Canada during 1923 amounted to 180,657 tons, valued at $7,207,005, an increase of 60,363 tons and $1,884,700 in value compared with the previous year. Production last year was the highest ever recorded. The value, however, while greater than in 1922 and 1921, shows a decrease from the peak year of the war.

German Dye Cartel Secures Supply of Coking Coal

The German dye cartel, which next to the railroads is the largest consumer of coal in the country, has insured itself of an ample supply of the coal best suited to the making of coal-tar products by acquiring control of the Rheinstahl concern of Düsseldorf. This concern is a large manufacturer of high-grade steel. In the course of its operations it secured extensive deposits of high-grade coking coal. A long term contract for the coal which the dye industry has been using was about to expire. It is claimed that the Rheinstahl coal is superior and will make for new efficiencies.

It is stated in the German press that the I. G. has succeeded in negotiating a loan in the United States for $2,500,000. The thought is advanced that the loan was arranged through the Bayer-Grasselli interests with the Warburgs in New York. The reduction of the tariff rates on dyes is understood to have had a bearing on the willingness of American bankers to advance the money. Since the amount of this loan is entirely inadequate to meet the credit requirements of all members of the I. G., it is thought that it is the forerunner of other American credits.

An investigation on the part of American interests looking to the purchase of intermediates in the Ruhr is thought to have developed the impracticability of such a plan.

That the German chemical industry is gathering momentum is revealed by the publication of employment figures which show that German chemical industries in 1922 had 51.77 per cent more full-time employees than was the case in 1913. This shows a steady advancement in employment since 1920. Comparable figures are not available for 1923 and 1924, but these years were abnormal due to the occupation of the Ruhr.

Chemical Foundation Replies to Government Brief

The Chemical Foundation, Inc., on Oct. 28 filed a brief in the United States Circuit Court of Appeals in which a defense is set forth of the purchase, through the Alien Property Custodian, of more than 6,000 German dye and chemical patents which had been seized during the war period. The brief contains 503 printed pages and is in reply to a brief filed several weeks ago by the government in its appeal to have the patents restored. The government contends that these patents, worth millions of dollars, were sold to the Chemical Foundation for $250,000 by Francis P. Garvan while he was Alien Property Custodian. The brief just filed by the Foundation states that the sale was made by A. Mitchell Palmer with the approval and sanction of the late President Wilson. An emphatic denial is made that Garvan and other federal officials, who later became connected with the Foundation, were in a conspiracy to violate the law in order to put through the sale to the Foundation. The hearing in the Court of Appeals on the case will begin Nov. 10.

Import Trade in Chemicals Larger in September

Exports Show Loss of Approximately $500,000 as Compared With Totals for August

The feature of foreign commerce in chemicals during September is a decided upturn in the imports of chemical production on the dutiable list. The imports under that classification in August aggregate $1,707,300. In September this total was $2,582,057. Imports of free list chemicals decreased during September. The September total was $5,550,656, as compared with $5,963,169 in August.

Despite the marked increase in the volume of dutiable chemical products brought into the country, there was a marked falling off in the imports of coal-tar chemicals. Coal-tar chemicals to the extent of 931,744 lb. were imported during September, whereas the imports in August totaled 1,728,781 lb. A part of the increase is represented by colors, dyes and stains. September imports amounted to 267,506 lb., as compared with 106,063 lb. in August.

Fertilizer imports increased from 109,445 tons in August to 141,028 tons in September. Paint, pigments and varnishes were imported to the extent of $194,185 or practically in the same volume as during August. While there were marked increases in the imports of barium compounds, chloride of ammonia and glycerine, for the most part the increase was well spread over the entire list. The detailed comparative figures covering certain imports follow:

	Sept., 1923	Sept., 1924
Arsenious acid, lb.	1,480,482	678,533
Citric acid, lb.	....	22,220
Formic acid, lb.	52,932	143,446
Oxalic acid, lb	157,394	187,786
Tartaric acid, lb.	189,304	251,260
Copper sulphate, lb.	....	243,159
Potassium carbonate lb.	1,766,924	749,722
Potassium hydroxide, lb.	683,755	802,495
Potassium chlorate, lb	....	758,265
Sodium cyanide, lb.	1,140,356	1,483,259
Sodium ferrocyanide, lb.	68,067	261,315
Sodium nitrite, lb.	123,499	400
Creosote oil, gal.	5,890,598	3,636,410
Naphthalene, lb.	1,545,952	111,467
Sodium nitrate, tons	51,543	68,017

Exports of chemicals and allied products during September were at a rate approximately half a million dollars below that of August. The September total was $8,543,951. Exports of coal-tar products were valued at $626,337. This shows a reduction of $375,000 as compared with August. There was a slight increase in the exports of sodas and sodium compounds. The September figure was 26,077,709 lb. Pigments, paints and varnishes to the extent of $1,066,467 were exported in September, a slight increase over August. Exports of fertilizer materials fell from 87,707 tons in August to 76,457 tons in September. September shipments of explosives to other countries show a decided upturn. In September exports were 1,805,560 lb., as compared with 1,234,799 lb. in August.

Comparative figures covering certain items on the export list follow:

	Sept. 1923	Sept. 1924
Bensol, lb.	3,756,916	1,204,116
Sulphuric acid, lb.	810,832	1,252,439
Acetate of lime, lb.	222,772	2,462,213
Bleaching powder, lb.	1,692,366	1,813,550
Potash chlorate, lb	11,877	40,083
Potash bichromate, lb.	170,156	186,509
Soda cyanide, lb.	135,445	203,946
Soda ash, lb.	2,992,502	3,026,045
Soda caustic, lb.	8,397,968	7,206,614
Sulphate of ammonia, tons	11,531	9,037

The figures are those of the Department of Commerce just compiled from the returns from the various ports of entry throughout the country.

German Indigo Plant Closed

According to advices from Germany, the prolonged fighting in China has interfered with industrial operations and has materially cut down Chinese consumption of indigo colors. German manufacturers who have found a wide outlet for indigo paste in China have been adversely affected and it is reported that the indigo section of the Badische plant at Ludwigshafen has been closed.

Frasch Estate Left for Research in Agricultural Chemistry

The will of Elizabeth Blee Frasch, widow of Herman Frasch, inventor of the process of mining sulphur by steam and founder of the Union Sulphur Co., was filed last Thursday. Mrs. Frasch died in Paris on Sept. 24. She inherited more than $5,000,000 on the death of her husband and her will provides that this money be held in trust by the United States Trust Co. and the income be used for "research in the field of agricultural chemistry, with the hope of attaining results which shall be of practical benefit to the agricultural development of the United States."

It is provided that the trustee after advising with the American Chemical Society select one or more incorporated institutions in the United States and pay the income to them upon the condition that they agree that the money will be devoted to research in agricultural chemistry.

Domestic Producers Report on Prices and Sales of Dyes

The Tariff Commission has received replies from about half of the domestic producers of coal-tar dyes in response to the questionnaire sent recently asking sales by quantity and total price for the first 9 months of 1924. The special census is being sought in preparation for a possible request from Congress for such data. In January a questionnaire asking sales for the last 3 months of the year will be sent out. It is expected that the comparison possible from the two sets of replies will afford a basis for determining to some degree the effect of the automatic reduction in the ad valorem duty on coal tar products which went into effect Sept. 22.

Z. L. Sault to Address Hartford Chapter, A.S.S.T.

The November meeting of the Hartford chapter of the American Society for Steel Treating will be held at the assembly hall of the Hartford Electric Light Co., Hartford, Conn., on Tuesday evening, Nov. 11. The principal speaker of the evening will be Z. L. Sault, president of the New England Annealing & Tool Co. Mr. Sault will speak on "Commercial Heat-Treating."

Personal

ERNEST DU PONT, president of the United States Flashless Powder Co., of Wilmington, Del., met with a serious accident at Newport News, Va., Oct. 18, breaking his leg between knee and hip. He was taken to the hospital at Fort Eustis.

E. L. HALL, chemical engineer and general superintendent of the Portland (Ore.) Gas & Coke Co., has been elected president of the Pacific Coast Gas Association for the year 1924-25.

Dr. ALFRED OBERLE has left the Universal Oil Products Co. to establish himself independently at 343 South Oak Park Ave., Oak Park, Ill. He is doing research work on hydrocarbons.

DAVID J. PRICE is on leave of absence for several months from the division of development work of the Bureau of Chemistry, to carry out some special engineering studies at the Pennsylvania State College. Mr. Price will probably be back in Washington to resume charge of his division about the first of the year.

JOSEPH A. RANK, secretary and treasurer of the Diamond State Fibre Co., Bridgeport, Pa., has been elected president of the Bridgeport National Bank, to succeed O. F. Lenhardt, deceased.

JAY ROBINSON, of the American Vulcanized Fibre Co., Wilmington, Del., gave an address on the subject of the "Transformation of Rags Into Paper and the Transformation of Paper Into Fiber" at a meeting of the Wolfe Chemical Club of the University of Delaware at the company's plant, Oct. 22.

ELLIOT M. SERGEANT announces the opening of his office at 515 Gluck Building, Niagara Falls, N. Y. He is prepared to undertake investigations, reports on industrial processes, design of plants and the general practice of chemical and industrial engineering.

SAM TOUR, metallurgist for the Doehler Die Casting Co., Batavia, N. Y., spoke before the Washington Chapter of the American Society for Steel Treating, Oct. 23, on Die Casting.

DAVID WARD, general manager of the By-Products Coke Corporation, Chicago, Ill., was the principal speaker at the meeting of the Eastern States Blast Furnace and Coke Oven Association, Pittsburgh Country Club, Pittsburgh, Pa., Oct. 17, speaking on the subject of "Coal and Its Relation to Coke Ovens and Blast-Furnace Operations."

JOHN J. WATSON, JR., has been elected president of the Republic Rubber Co., Youngstown, Ohio, to succeed E. H. Fitch, Jr., resigned. Mr. Watson is also chairman of the board of the Lee Rubber & Tire Co., the parent organization.

R. E. WILBUR, second vice-president, and J. GEORGE LEHMAN, general manager, of the Bethlehem Foundry & Machine Co., Bethlehem, Pa., acted as hosts to members of the local Rotary Club, Oct. 22, in an inspection tour at the company plant.

Industrial Notes

The United Alloy Steel Corporation, Canton, Ohio, has appointed L. G. Pritz vice-president in charge of all operations. Mr. Pritz has had a broad steel experience. Starting at the South Chicago plant of the Illinois Steel Co. in 1909, Mr. Pritz has served as turn foreman, melter, superintendent of electric furnace, and superintendent of special high-grade steels. Resigning as metallurgical engineer in charge of the high-grade specialty and alloy steel department, he became associated with the Timken Roller Bearing Co. in 1917. Resigning in 1922 as general superintendent of the steel works, where he had charge of electric furnaces, rolling mills and tube plant in the production of bearing steels, he became associated with the Sizer Steel Corporation of Buffalo as vice-president, specializing in the production of bar steel, die block steel, tool steel, bit steel and alloy steels for automotive parts. Mr. Pritz, while still a comparatively young man, is one of the oldest electric furnace men in the United States, and comes to the Alloy organization well fitted to carry on the work of producing alloy and specialty steels. The company also announces that J. G. Bell, who has been associated with the home office as sales and metallurgical engineer, has been transferred to the New York office, 1626 Pershing Square Building, to take the place of E. M. Littell, who recently resigned.

In March of this year Henry L. Doherty & Co. announced the acquisition, through the Combustion Utilities Corporation, of the Surface Combustion Co., Inc., industrial furnace engineer and manufacturer. The Combustion Utilities Corporation has just announced the consolidation of the personnel and activities of its appliance and industrial furnace departments with those of the Surface Combustion Co., Inc. The greater organization, continuing under the name of the Surface Combustion Co., Inc., will be the utilization division of Combustion Utilities Corporation. Under the consolidation Henry O. Loebell continues as president of the Surface Combustion Co., Inc., E. E. Basquin vice-president and general manager, W. M. Hepburn vice-president, Frank H. Adams treasurer and E. M. Doig secretary. Paul J. Nutting, formerly in charge of the Toledo appliance division of the Combustion Utilities Corporation, becomes vice-president in charge of production. C. B. Phillips, former sales manager Toledo division, becomes vice-president and sales manager of the stock furnace division, which will include all the well-known "Improved" and "Utility" appliances and the "Blue Line" furnaces. F. W. Manker, previously in charge of Combustion Utilities large furnace department, becomes vice-president and will be associated with Mr. Hepburn in the large furnace division. The Surface Combustion Co., Inc., sales and general offices will be continued at 366-368 Gerard Ave., New York, and all production at the Toledo works, 2288 Albion St., Toledo, Ohio.

The Conveyors Corporation of America, 326 West Madison St., Chicago, announces the appointment of the W. P. MacKenzie Co., 1234 Callowhill St., Philadelphia, as its sales representative in southeastern Pennsylvania and southern New Jersey. This organization will handle the sale of American steam jet ash conveyors, American cast-iron storage tanks, American air-tight doors for ash pits and boiler settings, and other specialties. Associated with W. P. MacKenzie in the sales organization are John Beard, J. E. Fulweiler, S. T. MacKenzie and W. R. Lunn. In addition to the sales of the American steam jet ash conveyor, the MacKenzie organization handles the sale of the products of the Alphons Custodis Chimney Construction Co., the International Filter Co., the Peabody Engineering Co., the L. J. Wing Manufacturing Co. and others.

The Armstrong Cork & Insulation Co., Pittsburgh, Pa., announces following changes in branch office addresses: The Cleveland office is now located at 2207-2221 East 14th St., Cleveland, Ohio. The Houston office is now located at 903 Keystone Building, Houston, Tex. New warehouse facilities have been established at Houston and the company's products are now carried in stock. The New Orleans office, of which H. T. Steffee is agent, has been moved to 928-930 Tchoupitoulas St.

Calendar

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, Smithsonian Institution, Washington, D. C., Dec. 29 to Jan. 3.

AMERICAN ASSOCIATION TEXTILE CHEMISTS AND COLORISTS, Bellevue-Stratford, Philadelphia, Dec. 6.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, Hotel Shenley, Pittsburgh, Pa., Dec. 3 to 6.

AMERICAN PETROLEUM INSTITUTE, annual meeting, Fort Worth, Tex., Dec. 9, 10 and 11.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York, Dec. 1 to 4.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS, New York, Dec. 1 to 3.

AMERICAN SOCIETY FOR TESTING MATERIALS, twenty-eighth annual meeting, Atlantic City, N. J., June 22 to 26, 1925.

FOREST PRODUCTS UTILIZATION CONFERENCE, National Museum, Washington, Nov. 19 to 20.

NATIONAL CONFERENCE ON UTILIZATION OF FOREST PRODUCTS, Washington, D. C., Nov. 19 and 20.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING, Grand Central Palace, New York, Dec. 1 to 4.

SOUTHERN EXPOSITION, Grand Central Palace, New York, Jan. 19 to 31, 1925.

Obituary

A. E. BOTCHFORD, superintendent of the Elk Tanning Co.'s plants at Ridgway and Sheffield, Pa., died at his home in Warren, Pa., Oct. 20, following an attack of angina pectoris. He was 68 years old.

Production of Chemicals Gains in October

Moderate Expansion in Output Reported —Consumers Show Interest in Contracts for 1925 Delivery

According to private reports, there was a moderate increase in the productioon of chemicals and allied products in October as compared with September. Business in general has been gaining and car loadings last month were unusually large. This increase in distribution may be taken as a fair barometer of the greater activity of industries into which chemicals enter. According to employment figures as compiled by the Department of Labor, the output of chemicals in September would indicate an increase of 1.8 per cent over August but still about 10 per cent under that of September last year.

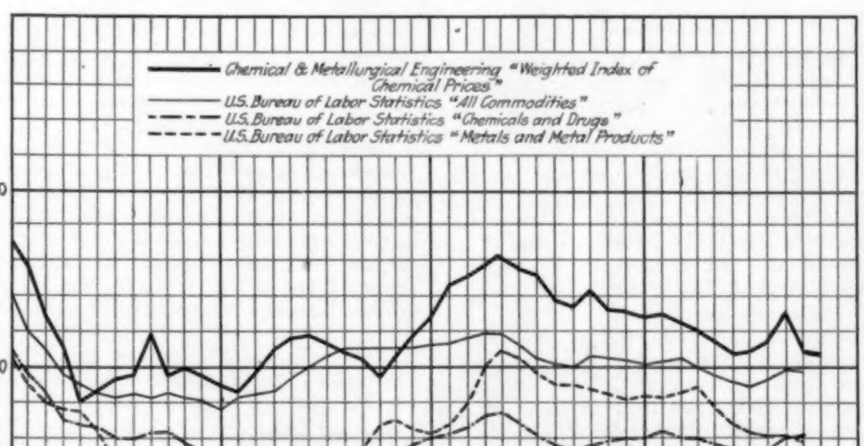
The weighted index number of *Chemical & Metallurgical Engineering* gives an average of 154.30 for October as compared with 154.72 for September and 167 for October, last year. While the index number in the past few months has been affected by violent fluctuations in vegetable oils and other allied products, the lower average for last month is fairly descriptive of the price tendency of chemicals. Most of the basic chemicals have held an unchanged price level, but bichromates, prussiates, arsenic, barium salts, permanganate of potash, nitrate of soda, citric, formic and tartaric acids have been quoted at reduced prices and have more than counterbalanced advances in other selections. In the latter part of the month the metal salts and pigments had worked into a strong position and the undertone to prices in general was steady to firm.

Trading in the spot market was spasmodic but reached a fairly large total. Considerable improvement was reported in the disposition of consuming industries to commit themselves on purchases for forward delivery. Among the materials which sold freely for future positions were mineral acids, linseed oil, bichromate of soda, prussiate of soda and nitrite of soda. Producers of alkalis did not announce new contract prices and the same was true of bleaching powder and liquid chlorine, but it is expected that announcement will be made shortly that the old prices will remain in effect.

Chemicals of foreign origin are holding their position in domestic markets. Official figures report a substantial gain in imports in September although the export trade in chemicals and kindred products was smaller than in August. One of the important developments in connection with imported chemicals was found in a report that foreign exporters had formed an agreement under which production and values for caustic potash were to be governed. Following this agreement the price for shipment was marked up and a firm market continued throughout the month.

The Bureau of Labor reports that wholesale prices in September receded somewhat from the August level. The Bureau's weighted index number, which includes 404 commodities or price series, declined to 148.8 for September, compared with 149.7 for August, and 153.7 for September, 1923.

The Bureau's index number for chemicals and drugs was 130.6 in September and 130.1 in August. Metals and metal products stood at 128.2 in September and 130.4 in August.



British Company Develops Quick Drying Enamel

An interesting test of the speed with which it is possible to coat an automobile body completely and efficiently was recently carried out in the presence of a gathering of automobile and other experts at the works of Robert Ingham Clark & Co., West Ham, England.

The feat was accomplished in 2 minutes 45 seconds and the enamel which was used, an entirely new product, is said to be the only celluloid enamel that can be applied to the body of an automobile by the "flowing" process. With the aid of a small hose with a ¼-in. nozzle, the operator "flowed" the enamel on to the metal of the car body, and the fluid dried so rapidly that a second coat was able to be applied within half an hour. Two hours later the car was fit for the road. The finished body had a beautiful rich tone, which, it was stated, would improve with age.

Financial

For the quarter ended Sept. 30, the American Zinc, Lead & Smelting Co. showed profit of $96,674, before depreciation and depletion. Profit for the first 9 months of 1924 totaled $185,533.

The Hercules Powder Co. for the 9 months ended Sept. 30, reports gross earnings of $15,596,488, against $17,102,835 in the same period last year, and net income of $1,510,253 after expenses, interest, taxes and depreciation reserves, against net income of $2,100,040 in the first 9 months of 1923.

The Corn Products Refining Co. for 9 months ended Sept. 30 received net income of $7,959,910, equivalent after preferred dividends to $2.62 a share earned on outstanding $63,250,000 common stock.

The Federated Metals Corporation has completed the merger of the Union Smelting & Refining Co., Newark; the Great Western Smelting & Refining Co., Chicago; the Eagle Smelting & Refining Co., New York; the Duquesne Reduction Co., Pittsburgh; the Trenton Smelting & Refining Co., Trenton, and B. Lissberger & Co.

Stockholders of the Prairie Oil & Gas Co. will be asked at the annual meeting, at Independence, Kan., on Dec. 9 to approve a proposal to increase the capital stock from $60,000,000 to $70,000,000 and to decrease par from a $100 to $25 a share.

The Sherwin-Williams Co. for the year ended Aug. 31 shows net profit of $3,562,607, equivalent after preferred dividends to $4.53 a share earned on outstanding $14,861,125 common stock. This compares with $4,881,379 or $6.54 a share in 1923.

For the first time since 1840 the Amoskeag Manufacturing Co. last week passed dividends on the common stock of the company. The company has paid quarterly dividends of 75c. on the common since Feb. 2, 1923, previous to which time it paid $1.50 quarterly on the stock which had been increased by a 100 per cent stock dividend in April, 1920. Annual rate on the old stock was $5.

Increase in Soya Bean Acreage

The acreage of soya beans grown for the grain in the Northern states, where the crop is rapidly gaining in favor, has increased about 25 per cent ths year, according to the Federal Crop Reporting Board. The total United States acreage grown for the beans, rather than for forage, this year is estimated at 534,000 acres, compared with 452,000 acres last year.

Alcohol Plant in Guatemala

A factory has been installed in Guatemala at Palin, for the manufacture of alcohol from sugar cane for industrial purposes. Successful experiments have been made with this alcohol as a substitute for gasoline in motor cars and it is expected to reduce the cost of motive power by 50 per cent.

Market Conditions

Consumers Show Interest in Contracts for Next Year Delivery

Considerable Business Reported to Have Been Placed for 1925 Requirements in Acids, Bichromates and Prussiates

VARIOUS consuming trades are reported to have taken interest in filling requirements over part of next year and contract trading has been more of a factor in the market. Producers of sulphuric acid and other heavy acids say they have accepted forward business during the week and similar reports are heard concerning bichromates and prussiates. Arsenic also has come in for attention and the low prices quoted for futures have resulted in business with indications that buyers are about ready to anticipate needs. Some domestic producers of nitrite of soda are said to have sold a good part of their production ahead. A good contracting movement has been reported in the linseed oil market and soap makers are credited with placing orders for nearby deliveries of different soap-making materials. While some contracts in alkalis are said to have been placed, the majority of buyers have held back pending the announcement of new contract prices. The latter are expected to be made known in the latter part of this week and, according to rumors, they will be unchanged from the present contract levels.

The weighted index number for the week was 154.79 which compares with 154.86 for the preceding week. The recession in the average price was due to lower selling levels for linseed oil and some allied products. Quotations for chemicals were steady with the metal salts still tending upward and the undertone in general steady.

Import figures for September have just been issued and bear out reports that foreign producers are shipping regularly to this country. Arrivals in September were of considerably larger volume than in August and manifests received in October would indicate that imports are holding up well. Shipments of dyes to this country have increased since the lower duty went into effect on September 22. Reports from Washington state that about one-half of domestic producers have returned the questionnaire to the Tariff Commission, giving data on prices and sales of domestic dyes. It is possible that this information may be used as a basis for bringing about a change in duties on coal-tars and dyes.

Acids

In addition to a good call for mineral acids for prompt delivery, there has been considerable business in later deliveries and producers are reported to be carrying numerous orders for 1925 delivery. Fair export demand is noted for sulphuric acid and outward shipments in September were 1,252,439 lb. Formic acid has been easy and sellers of imported have been willing to sell at 11c. per lb. on spot and at 10½c. per lb. for shipment. Imports of formic acid in September were 143,446 lb. and in the same month arrivals of oxalic acid from abroad reached a total of 187,786 lb. The latter is rather quiet at present with 9½c. per lb. the ruling quotation for spot material. Tartaric acid also is quiet at 25@25½c. per lb. Imports of the latter in September were large, amounting to 251,260 lb. Citric acid is dull and shipments of imported have fallen to a low level. Acetic acid is holding steady with a good call for the various grades.

Basic Carbonate of Lead and Lead Oxides Advanced — Arsenic Sells for Shipment—Imported Caustic Potash Strong on Spot—Formaldehyde Firm — Permanganate of Potash Firmer—Epsom Salts Higher in Forward Positions — Sal Ammoniac Unchanged — Contract Price for Alkalis Expected This Week

Potashes

Bichromate of Potash—While trading is reported to be rather quiet, the total movement recently has gained in volume over that of preceding weeks and lower prices have interested buyers. Asking prices range from 8½c. to 8¾c. per lb., according to quantity. The inside figure is quoted for contracts. Exports in September were 186,509 lb. as compared with 170,156 lb. in September last year.

Carbonate of Potash — Buying has continued light and prices are barely steady. Quotations for hydrated 80-85 per cent are held at 5c. per lb., with calcined 80-85 per cent at 5¼c. per lb. Imports in September were 749,722 lb.

Caustic Potash—Arrivals from abroad in September were 802,495 lb. This makes a total of 8,229,062 lb. for the first 9 months of the year and would indicate an ample supply in conjunction with the home output. The market, however, is in a firm position and spot caustic was held at an inside figure of 7¼c. per lb. Shipments were still quoted at 7½c. per lb.

Permanganate of Potash—Inquiry for imported permanganate found holders reserved and on moderate sized lots the best price named was 13c. per lb. On larger lots it is intimated that concessions would be granted especially in the way of granting free delivery but the general market was 13c. per lb., f.o.b. warehouse. Domestic makers were reported to be following the lead of importers and prices for the latter were given at 12¾@13c. per lb., at works.

Prussiate of Potash—Red prussiate is quiet with quotations at 36@37c. per lb. Yellow prussiate is finding a routine outlet with new business running light. For spot material sellers ask 16½@17c. per lb. and the inside figure is quoted for shipments.

Sodas

Bichromate of Soda—Producers have been accepting contract orders at 6½c. per lb. and this price has brought buyers into the market. Spot material and prompt shipment is quoted at 6⅝@6¾c. per lb. with quantity and seller accounting for the range.

Cyanide of Soda — Fair call is reported both from the domestic and export trade. Exports in September were 203,946 lb. as compared with 135,445 lb. in September last year. Imports also are running high with total arrivals in September at 1,483,259 lb. as against 1,140,356 lb. in the corresponding month last year. Domestic consumers are not only taking deliveries but have placed contracts for next year. The quoted price for standard material is 22c. per lb.

Caustic Soda—According to reports current in the trade, new contract prices will be announced after election but they will show no change from the present quotation of 3.10c. per lb. in carlots, f.o.b. works. There have been sellers for prompt and nearby shipment under that level. Consumption is reported to be heavy and producers as a rule are not forced to competitive tactics. Export inquiry is variously reported but is not up to the standards of last year. Exports in September were 7,206,614 lb. as compared with 8,397,968 lb. in September last year. Quotations for export are 2.85@3c. per lb.

Nitrite of Soda—Some domestic producers are said to have sold a good part of their production ahead. The prices quoted for contract business have varied according to quantities in question but have been below the levels

ruling for spot material. The latter is holding at 9¼c. per lb. The restrictions placed on the entering of foreign nitrite cut down imports in September and only 400 lb. was brought into this country or at least was released from bond.

Nitrate of Soda—A consular report from Chile says that export sales of nitrates during August, as announced by the Producers Association, amounted to only 21,467 metric tons, compared with 88,393 in the preceding month and 23,279 in August, 1923. Last month's sales were all for small lots for January-March delivery. Total sales up to the end of August were 1,367,532 metric tons as compared with 938,171 metric tons in the corresponding period of the preceding year. Arrivals in this country in September were 68,017 tons as compared with 51,543 tons in September last year. Spot nitrate continues to hold at $2.40@$2.42 per 100 lb., with demand quiet.

Prussiate of Soda — Imported prussiate on spot has shown a range according to seller with asking prices running from 9c. to 9¼c. per lb. On shipments from abroad 8¾c. per lb. can be done. It is stated that some consumers have covered requirements ahead. Imports in September were 261,315 lb. which compares with 68,067 lb. in September last year.

Miscellaneous Chemicals

Acetate of Lime—Material improvement in export business is revealed by the latest figures of the Department of Commerce. Outward shipments in September were 2,462,213 lb. in comparison with 727,709 lb. for August and 222,772 lb. for September, 1923. Some improvement also is reported in buying for domestic account and stocks are said to have been reduced at producing points. The price is unchanged at $3 per 100 lb.

Arsenic—An easier tone has been in evidence and domestic arsenic in large lots was offered at 6¾c. per lb. Inquiry for domestic arsenic was reported to be better but producers described trading as quiet. Imported arsenic was offered at 6¼c. per lb. for Japanese, spot and shipment, and European makes were quoted at 6½c. per lb. for shipment. It was stated that some buyers had placed orders for Japanese for shipment and in some quarters it was felt that buying would soon become active.

Bleaching Powder—The export outlet for bleaching powder has been good according to official figures, as exports in September amounted to 1,813,550 lb. Good call is felt from domestic users and the market is holding firm at $1.90 per 100 lb. in large drums, carlots, at works. No change was reported for liquid chlorine and sellers offer on a basis of 4¼c. per lb. in tanks, f.o.b. works.

Epsom Salts — While sales of imported were made at $1.25 per 100 lb. for shipment, this price was later withdrawn and the asking price become $1.32½ per 100 lb. Spot material was held at $1.35@$1.40 per 100 lb.

Formaldehyde—All sellers are credited with holding out for full quotation prices and 9c. per lb. is given as a firm price for carlots with premiums asked for smaller amounts.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	154.79
Last week	154.86
Nov., 1923	166.00
Nov., 1922	159.00
Nov., 1921	147.00
Nov., 1920	240.00
Nov., 1919	239.00
Nov., 1918	279.00

Heavy chemicals were fairly steady, but irregularity occurred in prices for some of the vegetable oils, linseed oil closing lower on spot. The index number was lowered 7 points.

Sal Ammoniac—A good demand has been in evidence for both imported and domestic. Imported white sal ammoniac is quoted at 6c. per lb. on spot and shipments are offered at 5¾c. per lb. Some buyers are giving the preference to domestic grades and the white is held at 7c. per lb. at works.

Alcohol

First hands reported a strong market for denatured alcohol, the recent advance in prices being maintained in all quarters. Demand for non-freezing solutions will open up soon and this should provide for quite a little additional business. Stocks continue moderate. There has been no recession in values for raw materials. Formula No. 1, special denatured, held at 55c. per gal., in drums, with completely denatured, formula, No. 5, at 54c. per gal., in drums.

Methanol was inactive and quotably unchanged. The 97 per cent grade held at 76c. per gal., in drums.

Butanol was in good demand and plants are operating to capacity. The market was nominal at 30c. per lb.

Coal-Tar Products

Buying Interest in Intermediates Improves and Prices Steady—Offerings of Crudes Moderate—Creosote Higher Abroad

INQUIRY for intermediates was more active, and producers generally reported more buying interest and fairly steady undertone. Price changes were few in the past week. Business was confined chiefly to nearby material as prices named on forward contracts were not attractive enough from the buyers' point of view. On the other hand first hands have been unable to obtain basic materials at concessions and in most instances sentiment as regards futures favors sellers. In crudes the market underwent comparatively little change. Production hardly changed and holdings are just about sufficient to meet current wants. In sulphate of ammonia the stocks virtually are down to nil and prices are wholly nominal. Benzene for immediate delivery ruled firm. Cresylic acid was unsettled, with some sellers willing to take on business at concessions. Phenol was in good request, deliveries on existing contracts absorbing most of the output. Aniline oil sold at unchanged prices. Naphthalene flake was offered quite freely on spot and prices were irregular. No further changes occurred in pyridine.

Aniline Oil and Salt—Demand was good and prices held firm in all quarters. Business was reported in aniline oil on the basis of 16c. per lb., drums extra, carload lots, f.o.b. works. Aniline oil for red was nominally unchanged at 40c. per lb. Aniline salt was offered at prices ranging from 20@22c. per lb.

Beta-naphthol—Orders for beta-naphthol were more numerous. The ideas of sellers were firmer, but this was not reflected by any price changes, the selling basis holding at 24@25c. per lb. on the technical.

Benzene— Conditions at producing centers underwent little or no change. This leaves stocks light and prices steady. Exports of benzene in September amounted to 1,204,116 lb. which compares with 3,756,916 lb. in September a year ago. The exports for the 9 months ended September amounted to 57,772,815 lb., which compares with 89,694,795 lb. in the same time a year ago. Producers had little surplus stock to offer and this accounts for the decline in export trade in this commodity. The market for 90 per cent benzene held at 23c. per gal., and the pure at 25c. per gal., tank car basis, f.o.b. works.

Creosote Oil—Imports of creosote oil in September amounted to 3,636,410 gal., which compares with 5,890,598 gal. in September 1923. Imports for the 9 months ended September were 67,278,013 gal., which compares with 45,865,138 gal. for the corresponding period a year ago. Manchester, England, reported increased buying interest from America and slightly higher prices, the nominal quotation advancing to 5½d. per gal., bulk basis, works.

Cresylic Acid—Offerings were more numerous and, with inquiry slow, prices were unsettled. There were offerings of the 97 per cent material at 62@64c. per gal. On futures, covering round lots, slightly better might have been done.

Naphthalene—Spot white flakes were available at 4¾@5¼c. per lb., with the undertone rather easy. On futures one producer named a price of 5½c. per lb., but prospective buyers showed no interest in this figure. Imports of crude naphthalene in September amounted to 111,467 lb., as against 1,545,952 lb. in September, 1923. Imports for the 9 months ended September amounted to 4,915,247 lb., which compares with 17,062 301 lb. for the corresponding period a year ago.

Phenol—U.S.P. material on spot sold at 25c. per lb., small drums, indicating that the price did not change in the past week. On large drums first hands quote 24c. per lb. The offerings were moderate and the undertone steady. One small lot of phenol arrived from Liverpool.

Vegetable Oils and Fats

Crude Cottonseed Oil Steady—Good Trading in Linseed Oil—Coconut Oil Advances—Tallow Sells at Concessions

WITH the exception of tallow the market for vegetable oils and fats was steady to firm. Trading in cottonseed oil for actual consumption was good and prices held in the face of pressure from refiners. Early in the week linseed oil was unsettled, but subsequent strength in flaxseed futures steadied the market and quite a little business was booked for nearby and early 1925 delivery. Offerings of coconut oil were scanty and asking prices were about ⅛c. higher. Heavy trading took place in tallow, but most of the business was placed at concessions from the recent high. Inquiry was in evidence of sardine oil for shipment from the Orient.

Cottonseed Oil—Favorable crop news and lower lard failed to make much of an impression on the market for cottonseed oil. The undertone was a shade easier, but net changes in prices were rather small. Speculative activity in refined oil was inactive. Refiners were more aggressive, but restricted their operations mainly to the bear side. Western longs, who have accumulated quite a little oil in the option market, appeared satisfied to await developments, for buying orders from Chicago were not numerous. Cash trade in both oil and compound was good, and most traders believe that October business will approximate 300,000 bbl. Just before the expiration of the October option refined prime summer yellow oil sold at 13c. per lb. Regarding the November position sentiment is mixed. It was hinted that a prominent refiner stood ready to deliver November contracts in a fairly large way in the event that the market should work higher. Crude oil sold at 8⅞@9c. per lb., tank cars, f.o.b. mills, Southeast, immediate shipment. In Texas immediate shipment oil held at 8⅞c. per lb. It was reported that a round lot of crude sold in Texas for November delivery at 8⅝c. per lb., tank car basis. Prime summer yellow in the New York market, on Thursday, settled at 10.55@10.60c. per lb., November option, 10.41@10.44c. per lb., January option, and 10.72@10.73c. per lb., May option. Lard compound on spot closed at 13¼c. per lb., carload lots. Pure lard in Chicago, cash, settled at 15.62c. per lb.

Linseed Oil—Trading was fairly active in the fore part of the week, paint manufacturers and linoleum makers taking hold. Most of the business was placed at prices ranging from 96@97c. per gal., cooperage basis, first quarter of 1925 delivery. Bids were in the market at these prices later, but an advance in flaxseed futures strengthened the ideas of crushers and before the close oil prices were raised from 1@2c. per gal. covering forward deliveries. Early November shipment oil was offered at \$1@\$1.01 per gal., cooperage basis, with late November at 98@99c. per gal., cooperage basis. Interest again centered in the flaxseed developments in the Argentine. Reports on the new crop were unfavorable, lack of rain causing further reductions in private estimates on production. Cables received here placed the exportable surplus at 28,000,000 to 32,000,000 bu. While the estimates may prove too low, trade authorities believe that serious damage has occurred to the crop and it is altogether possible that the world's supply of flaxseed for 1925 may be smaller than in 1924. The Northwestern markets for seed were all higher on futures, reflecting the unfavorable nature of the news from the Argentine. Receipts of domestic seed at the Northwestern terminals so far this season amounted to 12,000,000 bu., or almost one-half of the total estimated production. Cake for export was slightly lower at \$47.50@\$48 per ton, f.a.s. New York.

Smaller Imports of Oilseeds in 8 Months Ended August

Importations of oilseeds for the 8 months ended Aug. 31 were valued at \$40,039,911, which compares with \$54,031,452 for the same time a year ago. Statistics covering the 8 months period, with a comparison, follow:

	1924	1923
Cottonseed, lb.	37,216,019	17,340,286
Castor beans, lb.	61,140,613	63,244,771
Copra, lb.	190,516,552	217,946,108
from Philippines	157,963,451	161,263,486
Other countries	32,553,101	56,682,622
Flaxseed, bu.	15,400,114	20,728,614
from Canada	2,217,450	1,314,069
Argentina	13,181,689	19,241,241
Other countries	975	173,304
Poppy seed, lb.	1,448,316	3,067,209
Other oilseeds, free, lb.	19,606,809	19,615,717
Other oilseeds, dut., lb.	3,777,967	7,875,747

China Wood Oil—Early in the week prices were lower, but inquiry from consumers developed, steadying the market. Spot oil sold down to 15c., but closed at 15¼@15½c. asked, cooperage basis. On the Pacific coast 13½c. per lb. was asked for oil in tank cars, forward delivery.

Castor Oil—Seed is in scanty supply and high, causing prices for oil to hold at the recent advance. Some producers are not in a position to quote on prompt shipment oil. Technical, or No. 3 oil, held at 17c. per lb., in bbl.

Corn Oil—Crude oil sold at 9⅜c. per lb., tank cars, Chicago, a decline of ¼c.

Coconut Oil — Offerings were small and with copra higher prices were raised ⅛c. per lb. Ceylon type oil on spot, New York, closed at 10¼c. per lb., tank car basis. On the coast 9⅝c. was asked for prompt oil, and 9½c. for January forward, tank car basis.

Other Vegetable Oils — Sesame oil, refined, sold at 13c. per lb., whole of 1925 delivery, equal monthly shipments. Refined rapeseed oil sold on spot at 97c. per gal., with futures nominal at 95@96c. per gal. Lagos palm oil nominal at 9¼c., future delivery. Niger palm oil, November delivery, 8⅝c. per lb. Crude soya, tank cars, duty paid, 11@11¼c. per lb., f.o.b. Pacific coast ports, future shipment.

Fish Oils—Crude menhaden oil was offered in a limited way at 55c. per gal., tank cars, Baltimore, and 52½c. per gal., North Carolina. Crude sardine oil for shipment from the Orient sold recently at 45c. per gal., Pacific coast, but settled last week at 50c. bid, with no sellers.

Tallow, Etc.—After selling at 9⅜c. per lb., the market for extra special tallow eased off on freer offerings of outside goods and several round lots changed hands at 9⅛c. per lb., f.o.b. plant. Oleo stearine sold at 13c. per lb., a decline of ½c. Red oil advanced to 10¼c. per lb.

Miscellaneous Materials

Antimony—Advices from the Orient reported firmer prices and this stiffened the market here. Chinese antimony was advanced ⅛c. per lb., the revised quotation being 11⅞c. per lb. Cookson's "C" grade was firm, but unchanged at 14¼@14½c. per lb. There was no change in oxide or needle antimony.

Glycerine—There was an easier feeling in crude, but no important changes took place in prices asked. Demand was moderate and refiners, in some instances, have been taking on foreign material. Crude soap lye glycerine, basis 80 per cent, was offered at 11⅞c. per lb., loose, carloads, f.o.b. point of production. Saponification, 88 per cent, was nominally unchanged at 13c. asked, loose. Dynamite sold recently at 17⅞c. per lb., in drums, carload lots, Middle West. Chemically pure was available at 18¼c. in the Middle West, and at 18⅞@19c. in New York.

Litharge — In sympathy with the higher market for pig lead carroders advanced prices for litharge ⅜c. per lb. in the past week. This establishes the carload price at 11¼c. per lb., in bbl.

Orange Mineral—Closing prices were ⅜c. per lb. higher than a week ago, reflecting the sharp advance which occurred in pig lead. Corroders now quote 14⅜c. per lb., in csk. or bbl., carload basis.

White Lead—The market for pig lead was active and higher, advancing to 8.65c. per lb. Offerings increased after the advance. The buying movement was not unexpected, as general expansion in consuming industries has set in. Corroders advanced the market for white lead and red lead on 2 occasions in the past week, both changes amounting to ¼c. per lb. This establishes the market for white lead, dry, basic carbonate at 10¼c. per lb., and sublimed at 10@10¼c. per lb., in bbl. or casks. Blue lead was raised to 10c. per lb. and red lead to 11⅜c. per lb. The uplift in pigments was due to the higher market for the metal.

Zinc Oxide — Producers reported a steady but unchanged market. The metal was higher, yet keen competition held down prices for oxide. American process, lead free, was offered at 7⅞c. per lb., in bags. French process, red seal, 9⅜c. per lb., in bags. Demand fair.

Imports at the Port of New York

October 24 to October 30

ACIDS—Cresylic—6 dr., Glasgow, Order. **Coal-tar**—5 csk., Rotterdam, Grasselli Dyestuff Corp. **Oxalic**—12 csk., Rotterdam, Order. **Phenol**—69 kegs, Liverpool, Monsanto Chemical Co. **Stearic**—20 cs., Rotterdam, M. W. Parsons & Plymouth Organic Lab.

ALCOHOL—275 bbl. and 25 dr. denatured, San Juan, C. Estevas.

AMMONIUM CARBONATE — 10 bbl., Liverpool, Order.

ANTIMONY—34 csk., Newcastle, S. Fullwood; 320 bg., Antofagasta, Anglo-South American Trust Co.

ANTIMONY REGULUS—150 cs., Shanghai, Wah Chang Trading Corp.; 50 cs., Shanghai, F. A. Cundill & Co.; 100 cs., Shanghai, Nassau Smelting & Refining Co.

ANTIMONY SULPHIDE—75 csk., Newcastle, S. Fullwood.

ASBESTOS—1,334 bg. crude, Beira, W. D. Crumpton & Co.

BARIUM CHLORIDE—69 csk., Rotterdam, Goldschmidt Corp.

BARIUM HYDRATE — 5 csk., London, Toch Bros.

BARYTES—10 bg., Calcutta, Order.

BRONZE POWDER — 20 cs., Bremen, Gerstendorfer Bros.; 33 cs., Bremen, Uhlfelder & Co.; 3 cs., Hamburg, Koeller, Struss & Co.

CAMPHOR—110 cs., Hamburg, Equitable Trust Co.

CHALK — 500 tons, London, Taintor Trading Co.; 300 bg., Antwerp, National City Bank; 400 bg., Antwerp, Brown Bros. & Co.; 500 bg., Antwerp, Reichard-Coulston, Inc.

CHEMICALS—56 csk., Glasgow, Frazer & Co.; 280 bg., Glasgow, Coal & Iron National Bank; 6 cs., Gothenburg, Harrison, Clark & Co.; 280 bg., Glasgow, Coal & Iron National Bank; 24 bbl., Bremen, Stanley Doggett, Inc.; 106 cs., Rotterdam, Hans Henrichs Chem. Co.; 15 pkg., Hamburg, Schering & Glatz; 10 csk., Hamburg, P. Uhlich & Co.; 15 csk., Hamburg, Order; 250 bbl., Hamburg, Order.

CHROME ORE—1 lot (in bulk), Beira, E. J. Lavino & Co.

COAL-TAR DISTILLATE — 162 dr., Liverpool, Order.

COLORS — 24 csk., ultramarine blue, Glasgow, A. Maharrie; 2 csk. aniline, Genoa, Banca Comm. Italia; 31 csk. do., Genoa, Order; 69 csk. earth, Bremen, Heller & Merz Co.; 2 csk. alizarine, Rotterdam, Kuttraff, Pickhardt & Co.; 63 pkg. aniline, Rotterdam, H. A. Metz & Co.; 7 cs. aniline, J. W. Warnecke; 26 csk. do., Rotterdam, Grasselli Dyestuff Corp.; 4 csk. dry, Hamburg, H. A. Metz & Co.; 3 csk. do., Hamburg, Franklin Import & Export Co.; 11 pkg. do., Hamburg, Kuttroff, Pickhardt & Co.; 5 pkg. aniline, Antwerp, Order.

DIVI-DIVI—773 bg., Pampatar, Eggers & Heinlein.

FLUORSPAR — 737 tons, Newcastle, Order.

GALLNUTS—400 bg., Shanghai, Order.

GLYCERINE—20 dr., Marseilles, Order; 10 dr. Marseilles, Core & Herbert; 30 dr. crude, Havana, Marx & Rawolle; 43 dr. crude, London, Order.

GUMS—64 bg., Singapore, Brown Bros. & Co.; 54 cs. kauri, Auckland, Brown Bros. & Co.; 20 cs. do., Auckland, Chemical National Bank; 350 cs. do., Auckland, Baring Bros., & Co.; 74 bg. do., Auckland, Equitable Trust Co.; 245 pkg. do., Auckland, Guaranty Trust Co.; 222 cs. do., Auckland, Order; 116 bg. copal, London, Toch Bros.; 203 pkg. copal, Manila, Chartered Bank of India, Australia & China; 64 bg. damar, Singapore, Brown Bros. & Co.; 423 bg. copal, Macassar, Kidder, Peabody & Co.; 67 bg. do., Macassar, A. Klipstein & Co.; 735 bg. do., Macassar, L. C. Gillespie & Son.; 17 bg. do.; Macassar, France, Campbell & Darling; 266 bg. do., Macassar, Order; 50 cs. damar, Batavia, Am. Exchange National Bank; 224 bg. damar, Singapore, Baring Bros. & Co.; 67 bg. damar, London, Baring Bros. & Co.; 340 bg. copal, Antwerp, Order.

IRON OXIDE—274 bbl., Malaga, C. J. Osborn & Co.; 46 bbl., Malaga, Hummel & Robinson; 168 bbl, Malaga, Reichard-Coulston, Inc.; 80 bbl., Malaga, J. Lee Smith & Co.; 426 bbl., Malaga, C. K. Williams & Co.; 30 bbl., Malaga, Order; 10 csk., Liverpool, Scott, Libby & Co.; 11 csk., Liverpool, Reichard-Coulston, Inc.; 18 csk., Liverpool, J. A. McNulty.

IRON PERCHLORIDE — 27 csk., Hamburg, Mallinckrodt Chemical Works.

INFUSORIAL EARTH—344 bg., Oran, Order.

LITHOPONE—75 csk., Antwerp, E. M. & F. Waldo.

MAGNESIUM CARBONATE — 57 cs., Newcastle, Order.

MANGROVE BARK — 500 bg. extract, Batavia, Order; 500 bg., Singapore, Order.

MINERAL WHITE — 1,200 bg., Hull, Hammill & Gillespie.

NUX VOMICA—308 cs., Coconada, Volkart Bros.; 2,000 pkts., Calcutta, Order.

OCHER — 158 bbl., Marseilles, J. Lee Smith & Co.; 322 bbl., Marseilles, Reichard-Coulston, Inc.; 59 bbl., Marseilles, L. H. Butcher Co.

OILS—Cod—400 csk., St. Johns, National Oil Products Co.; 25 csk., St. Johns, R. Badcock & Co.; 120 csk., St. Johns, Swan & Finch; 100 bbl., Aberdeen, Order. **China Wood**—276 csk., Shanghai, W. R. Grace & Co.; 272 csk., Shanghai, Paterson, Boardman & Knapp; 35 dr., Shanghai, F. A. Cundill & Co. **Coconut**—851 tons (in bulk), Manila, Spencer Kellogg & Sons. **Linseed**—29 bbl., Hull, International Composition Co. **Olive foots** (sulphur oil)—400 bbl., Piraeus, A. Dimoulitsas; 100 bbl., Leghorn, Leghorn Trading Co.; 200 bbl., Palermo, Order; 100 bbl., Patras, Order; 600 bbl., Bari, Order. **Palm Kernel**—69 csk., Hull, Order. **Palm**—186 csk., Liverpool, Order; 199 csk., Hamburg, Order. **Peanut**—280 cs., Bordeaux, American Shipping Co. **Rapeseed**—220 bbl., Hull, Order. **Seal**—103 csk., St. Johns, Bowring & Co.; 19 csk., St. Johns, E. H. Laing. **Sperm**—100 bbl., Glasgow, Order.

OILSEEDS—Castor—16,388 bg., Coconada, Volkart Bros.; 8,827 bg., Coconada, Order; 1,000 bg., Santos, Seabord National Bank; 27 bg., Port au Prince, S. L. Brinley; 25 bg., Port au Paix, W. Leaman. **Copra**—30 bg., San Juan, Franklin Baker Co.

PITCH—51 bbl., Liverpool, Order.

PLUMBAGO—94 bbl., Colombo, National City Bank; 100 bbl., Colombo, H. W. Peabody & Co.

POTASSIUM SALTS — 10 csk. caustic, Gothenburg, W. F. Eissing; 25 cs. caustic, Gothenburg, Mallinckrodt Chemical Works; 18 kegs prussiate, Liverpool, Order; 1,750 bg. muriate, Antwerp, Societe Comm. des Potasses d'Alsace; 1 lot manure salt (in bulk), Antwerp, Societe Comm. de Potasses d'Alsace.

PYRIDINE—3 dr., Liverpool, Monsanto Chemical Co.

QUEBRACHO—3,926 bg., Buenos Aires, First National Bank of Boston; 13,840 bg., Buenos Aires, Commonwealth Atlantic National Bank; 6,000 bg., Buenos Aires, Goldman, Sacks & Co.; 6,022 bg., Buenos Aires, Order; 2,877 bg., Buenos Aires, International Products Co.

QUICKSILVER — 700 flasks, Genoa, Order; 300 flasks, London, A. H. Pickering & Co.; 200 flasks, from San Francisco, Order.

SAL AMMONIAC—102 csk., Hamburg, Order.

SHELLAC—100 bg., Calcutta, Mitsui & Co.; 384 bg., Calcutta, Marx & Rawolle; 100 bg., Calcutta, Mechanics & Metals National Bank; 100 bg., Calcutta, Standard Bank of South Africa; 300 bg. garnet, Calcutta, First National Bank of Boston; 3,507 bg., Calcutta, Order; 31 cs., Rotterdam, C. F. Gerlach; 275 bg., Calcutta, First National Bank of Boston; 150 bg., Calcutta, Brown Bros. & Co.; 100 bg., Calcutta, Bank of London & South America; 460 bg., Calcutta, Marx & Rawolle; 1,607 bg., Calcutta, Order.

SIENNA—20 bg., Leghorn, L. H. Butcher & Co.

SILICON—1,011 tons, Calcutta, Perin & Marshall.

SODIUM SALTS—200 bbl. chloride, Barcelona, E. Suter & Co.; 168 cs. cyanide, Marseilles, International Banking Corp.; 10 cs. caustic, Gothenburg, W. F. Eissing; 34,476 bg. nitrate, Iquique, W. R. Grace & Co.; 202 dr. sulphohydrate, Rotterdam, C. S. Grant & Co.; 170 csk. prussiate, Rotterdam, Order; 6845 bg. nitrate, Antofagasta, Anglo-South American Trust Co.; 6,902 bg. do., Iquique, A. Gibbs & Co.; 6,833 bg. do., Iquique, Anglo-South American Trust Co.; 123,397 bg. (to Boston), Caleta Coloso, etc., W. R. Grace & Co.; 150 dr. cyanide, Liverpool, Order; 2,258 bg. nitrate and 246 csk. nitrite, Christiania, Order.

SIENNA—250 bg., Leghorn, F. B. Vandegrift & Co.

SILVER CHLORIDE — 395 bg., Arica, Duncan, Fox & Co.

STARCH — 400 bg. potato, Rotterdam, Stein, Hall & Co.

SUMAC—224 bg. ground, Palermo, E. M. Sergeant Co.; 100 bl. leaves, Palermo, Guaranty Trust Co.; 350 bg. ground, Palermo, R. Neumann Co.; 350 bg. do., Palermo, J. S. Young & Co.; 1,330 bg. do., Palermo, Order.

TALC—450 bg., Genoa, L. A. Salamon & Bros.; 200 bg., Genoa, Kountze Bros.; 500 bg., Genoa, Italian Discount & Trust Co.; 800 bg., Genoa, C. Mathieu; 250 bg. Genoa, Order.

TARTAR — 403 bg., Marseilles, Royal Baking Powder Co.; 549 bg., Marseilles, C. Pfizer & Co.; 108 bg., Lisbon, C. Pfizer & Co.; 2,693 bg., Buenos Aires, Royal Baking Powder Co.; 567 bg., Buenos Aires, C. Pfizer & Co.; 326 bg., Alicante, Tartar Chemical Works; 132 bg., Alicante, Royal Baking Powder Co.; 213 bg., Valencia, C. Pfizer & Co.; 357 bg., Valencia, Royal Baking Powder Co.

WAXES—222 bg. carnauba, Para, Order; 40 bg. beeswax, Antilla, Order; 20 cs. do., St. Nazaire, Order; 18 bg. beeswax, Azua, Mecke & Co.; 100 cs. spermaceti, Glasgow, Order; 7 bg. beeswax, Santa Domingo, Order; 40 bg. mineral, Hamburg, L. S. Tainter; 800 bg. paraffine, London, Order; 34 bl. beeswax, Rotterdam, Ponds Extract Co.

WOOL GREASE — 100 bbl., Bremen, Pfaltz & Bauer.

WHITING—1,000 bg., Antwerp, National City Bank.

WHITE LEAD—3 csk. and 50 kegs, London, J. Lee Smith & Co.

WITHERITE — 1,000 bg. ground, Newcastle, R. W. Graff & Co.; 250 bg. do., Newcastle, Order.

ZINC OXIDE—50 bbl., Marseilles, Reichard-Coulston, Inc.; 50 bbl., Marseilles, American Exchange National Bank; 25 bbl., Marseilles, Order; 5 cs., Antwerp, Philipp Bros.

Opportunities in the Foreign Trade

Parties interested in any of the following opportunities may obtain all available information from the Bureau of Foreign and Domestic Commerce at Washington or from any district office of the bureau. The number placed after the opportunity must be given for the purpose of identification.

ALOCHOL, WOOD. Patras, Greece. Purchase.—11,912.

CHEMICALS, INDUSTRIAL. Buenos Aires, Argentina. Agency.—11,894.

CHEMICALS, bulk and other heavy. Johannesburg, South Africa. Agency. —11,913.

COTTONSEED OIL. Trieste, Italy. Agency.—11,929.

OILSEED CAKES. Belgium. Purchase.—11,982.

SULPHUR. Germany. Purchase.—12,001.

CAUSTIC SODA. Germany. Purchase.—12,001.

CHEMICALS, HEAVY. Brazil. Agency. —11,968.

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

Industrial Chemicals

Acetone, drums, works	lb.	$0.16 – $0.16½
Acetic anhydride, 85%, dr.	lb.	.34 – .36
Acid, acetic, 28%, bbl.	100 lb.	3.12 – 3.37
Acetic, 56%, bbl.	100 lb.	5.85 – 6.10
Acetic, 80%, bbl.	100 lb.	8.19 – 8.44
Glacial, 99½%, bbl.	100 lb.	11.01 – 11.51
Boric, bbl.	lb.	.09 – .09½
Citric, kegs	lb.	.45½ – .46½
Formic, 85%	lb.	.11 – .11½
Gallic, tech.	lb.	.45½ – .47
Hydrofluoric, 52%, carboys	lb.	.11 – .12
Lactic, 44%, tech., light, bbl.	lb.	.12½ – .13
22% tech., light, bbl.	lb.	.06 – .06½
Muriatic, 18° tanks	100 lb.	.80 – .85
Muriatic, 20°, tanks	100 lb.	.95 – 1.00
Nitric, 36°, carboys	lb.	.04 – .04½
Nitric, 42°, carboys	lb.	.04½ – .05½
Oleum, 20%, tanks	ton	16.00 – 17.00
Oxalic, crystals, bbl.	lb.	.09½ – .09¾
Phosphoric, 50% carboys	lb.	.07 – .08
Pyrogallic, resublimed	lb.	1.55 – 1.60
Sulphuric, 60°, tanks	ton	8.00 – 9.00
Sulphuric, 60°, drums	ton	12.00 – 13.00
Sulphuric, 66°, tanks	ton	13.00 – 14.00
Sulphuric, 66°, drums	ton	17.00 – 18.00
Tannic, U.S.P., bbl.	lb.	.65 – .70
Tannic, tech., bbl	lb.	.45 – .50
Tartaric, imp., powd., bbl.	lb.	.26 – .27
Tartaric, domestic, bbl.	lb.	.29 – .30
Tungstic, per lb.	lb.	1.20 – 1.25
Alcohol, butyl, drums, wks.	lb.	.30 – .....
Ethyl, 190 p'f. U.S.P., bbl.	gal.	4.89 – .....
Denatured, 190 proof No. 1, special bbl.	gal.	.61 – .....
No. 1, 190 proof, special, dr.	gal.	.55 – .....
No. 1, 188 proof, bbl.	gal.	.65 – .....
No. 1, 188 proof, dr.	gal.	.58 – .....
No. 5, 188 proof, bbl.	gal.	.60 – .....
No. 5, 188 proof, dr.	gal.	.55 – .....
Alum, ammonia, lump, bbl.	lb.	.03½ – .04
Potash, lump, bbl.	lb.	.02¾ – .03½
Chrome, lump, potash, bbl.	lb.	.05½ – .06
Aluminum sulphate, com., bags	100 lb.	1.35 – 1.40
Iron free, bags	lb.	2.35 – 2.45
Aqua ammonia, 26°, drums	lb.	.06½ – .06¾
Ammonia, anhydrous, cyl.	lb.	.28 – .30
Ammonium carbonate, powd. tech., casks	lb.	.12½ – .12¾
Nitrate, tech., casks	lb.	.09 – .10
Amyl acetate tech., drums	gal.	3.50 – 3.75
Antimony oxide, white, bbl.	lb.	.12 – .12½
Arsenic, white, powd., bbl.	lb.	.06½ – .06¾
Red, powd., kegs	lb.	.14½ – .15½
Barium carbonate, bbl.	ton	55.00 – 56.00
Chloride, bbl.	ton	70.00 – 72.00
Dioxide, 88%, drums	lb.	.17½ – .18
Nitrate, casks	...	.07½ – .07¾
Blanc fixe, dry, bbl.	lb.	.03½ – .03¾
Bleaching powder, f.o.b. wks., drums	100 lb.	1.90 – .....
Spot N. Y. drums	100 lb.	2.20 – 2.25
Borax, bbl.	lb.	.05 – .05¼
Bromine, cases	lb.	.34 – .38
Calcium acetate, bags	100 lb.	3.00 – 3.05
Arsenate, dr.	lb.	.08 – .08½
Carbide, drums	lb.	.05 – .05¼
Chloride, fused, dr. wks.	ton	21.00 – .....
Gran. drums works	ton	27.00 – .....
Phosphate, mono, bbl.	lb.	.06½ – .07½
Carbon bisulphide, drums	lb.	.06 – .06½
Tetrachloride, drums	lb.	.06½ – .07
Chalk, precip.—domestic, light, bbl.	lb.	.04½ – .04½
Imported, light, bbl.	lb.	.04½ – .05
Chlorine, liquid, tanks, wks.	lb.	.04½ – .....
Contract, tanks, wks.	lb.	.04½ – .....
Cylinders, 100 lb., wks.	lb.	.05½ – .07½
Cobalt, oxide, bbl.	lb.	2.10 – 2.25
Copperas, bulk, f.o.b. wks.	ton	15.00 – 16.00
Copper carbonate, bbl.	lb.	.17 – .17½
Cyanide, drums	lb.	.49 – .50
Oxide, kegs	lb.	.16 – .16½
Sulphate, dom., bbl.	100 lb.	4.40 – 4.65
Imp. bbl.	100 lb.	4.37½ – .....
Cream of tartar, bbl.	lb.	.20½ – .21
Epsom salt, dom., bbl.	100 lb.	1.75 – 2.00
Imp., tech., bags	100 lb.	1.35 – 1.40
U.S.P., dom., bbl.	100 lb.	2.10 – 2.35
Ether, U.S.P., dr concent'd.	lb.	.13 – .14
Ethyl acetate, 85%, drums	gal.	.92 – .95
Acetate, 99%, dr.	gal.	1.08 – 1.10
Formaldehyde, 40%, bbl.	lb.	.09 – .09½
Fullers earth—f.o.b. mines	ton	7.50 – 18.00
Furfural, works, bbl.	lb.	.25 – .....
Fusel oil, ref., drums	gal.	4.00 – 4.50
Crude, drums	gal.	2.90 – 3.00
Glaubers salt, wks., bags	100 lb.	1.20 – 1.40
Imp., bags	100 lb.	.85 – .95
Glycerine, c. p., drums extra.	lb.	.18½ – .19
Crude 80%, loose	lb.	.11½ – .12
Hexamethylene, drums	lb.	.66 – .70

THESE prices are first-hand quotations in the New York market for industrial chemicals, coal-tar products and related materials used in the industries that produce

Dyes	**Paper and Pulp**
Paint and Varnish	**Petroleum**
Ceramic Materials	**Soap**
Fertilizers	**Explosives**
Rubber	**Food Products**
Sugar	**Metal Products**

Whenever available these prices are those of the American manufacturer. If for material f.o.b. works or on a contract basis, quotations are so designated. All prices refer to large quantities in original packages.

Lead:		
White basic carbonate, dry, casks	lb.	$0.10½ – .....
White, basic sulphate, casks	lb.	.10 – .....
White, in oil, kegs	lb.	.1240 – .....
Red, dry, casks	lb.	.11½ – .....
Red, in oil, kegs	lb.	1362 – .....
Acetate, white crys., bbl.	lb.	.15 – .....
Brown, broken, casks	lb.	.14 – .....
Arsenate, white crys., bbl.	lb.	.16 – .18
Lime-Hydrated, b.g., wks.	ton	10.50 – 12.50
Bbl., wks.	ton	18.00 – 19.00
Lump, bbl.	280 lb.	3.63 – 3.65
Litharge, comm., casks	lb.	.11½ –
Lithopone, bags	lb.	.06 – .06¼
Magnesium carb., tech., bags	lb.	.07 – .08
Methanol, 95%, bbl.	gal.	.74 – .76
97%, bbl.	gal.	.76 – .79
Pure, tanks	gal.	.76 – .....
drums	gal.	.78 – .80
bbl.	gal.	.83 – .85
Methyl-acetone, t'ks.	gal.	.70 – .....
Nickel salt, double, bbl.	lb.	.09½ – .10
Single, bbl.	lb.	.10 – .11
Orange mineral, csk.	lb.	.14½ – .14¾
Phosgene	...	.60 – .75
Phosphorus, red, cases	lb.	.70 – .75
Yellow, cases	lb.	.37½ – .40
Potassium bichromate, casks.	lb.	.08½ – .08¾
Bromide, gran., bbl.	lb.	.36 – .38
Carbonate, 80-85%, calcined, casks	lb.	.05 – .06½
Chlorate, powd.	lb.	.06½ – .08¼
Cyanide, drums	lb.	.47 – .52
First sorts, cask	lb.	.08½ – .08½
Hydroxide (caustic potash) drums	lb.	.07½ – .....
Iodide, cases	lb.	3.65 – 3.75
Nitrate, bbl.	lb.	.06 – .07½
Permanganate, drums	lb.	.13 – .13½
Prussiate, red, casks	lb.	.37 – .38
Prussiate, yellow, casks	lb.	.16½ – .17
Salammoniac, white, gran., casks, imported	lb.	.06 – .06½
White, gran., bbl., domestic	lb.	.07½ – .08
Gray, gran., casks	lb.	.08 – .09
Salsoda, bbl.	100 lb.	1.20 – 1.40
Salt cake (bulk) works	ton	16.00 – 17.00
Soda ash, light 58% flat, bulk, contract	100 lb.	1.25 – .....
bags, contract	100 lb.	1.38 – .....
Dense, bulk, contract, basis 58%	100 lb.	1.35 – .....
bags, contract	100 lb.	1.45 – .....
Soda, caustic, 76%, solid, drums contract	100 lb.	3.10 – .....
Caustic, ground and flake, contracts, dr.	100 lb.	3.50 – 3.85
Caustic, solid, 76% f.a.s. N. Y.	100 lb.	2.85 – 3.05
Sodium acetate, works, bbl.	lb.	.05 – .05¼
Bicarbonate, bulk	100 lb.	1.75 – .....
Bichromate, casks	lb.	.06½ – .06¾
Bisulphate (niter cake)	ton	6.00 – 7.00
Bisulphite, powd., U.S.P., bbl.	lb.	.04½ – .04½
Chlorate, kegs	lb.	.06½ – .06¾
Chloride	long ton	12.00 – 13.00
Cyanide, cases	lb.	.19 – .22
Flouride, bbl.	lb.	.08½ – .09
Hyposulphite, bbl.	lb.	.02½ – .02½
Nitrite, casks	lb.	.09½ – .09¾
Peroxide, powd., cases	lb.	.23 – .27
Phosphate, dibasic, bbl.	lb.	.03½ – .03¾
Prussiate, yel. bbl.	lb.	.09 – .09¼
Salicylate, drums	lb.	$0.38 – $0.40
Silicate (40°, drums)	100 lb.	.75 – 1.16
Silicate (60°, drums)	100 lb.	1.75 – 2.00
Sulphide, fused, 60-62%, drums	lb.	.02¾ – .0[illegible]
Sulphite, crys., bbl.	lb.	.02 – .02[illegible]
Strontium nitrate, powd., bbl	lb.	.09 – .09
Sulphur chloride, yel drums	lb.	.04½ – .0[illegible]
Crude	ton	18.00 – [illegible]
At mine, bulk	ton	16.00 – 18.00
Flour, bag	100 lb.	2.25 – 2.35
Dioxide, liquid, cyl.	lb.	.08 – .08½
Tin bichloride, bbl.	lb.	.13¾ – .....
Oxide, bbl.	lb.	.54 – .....
Crystals, bbl.	lb.	.35 – .....
Zinc carbonate, bags	lb.	.12 – .14
Chloride, gran., bags	lb.	.06 – .07
Cyanide, drums	lb.	.40 – .41
Dust bbl.	lb.	.08 – .08½
Oxide, lead free, bags	lb.	.07¾ – .....
5% lead sulphate bags	lb.	.06¾ – .....
French, red seal, bags	lb.	.09¾ – .....
French, green seal, bags.	lb.	.10¾ – .....
French, white seal, bbl.	lb.	.11¾ – .....
Sulphate, bbl.	100 lb.	3.25 – 3.50

Coal-Tar Products

Alpha-naphthol, crude, bbl.	lb.	$0.60 – $0.62
Alpha-naphthol, ref., bbl.	lb.	.75 – .80
Alpha-naphthylamine, bbl.	lb.	.35 – .36
Aniline oil, drums	lb.	.16 – .16½
Aniline salt, bbl.	lb.	.19 – .21
Anthracene, 80%, drums	lb.	.70 – .75
Anthraquinone, 25%, drums.	lb.	.70 – .75
Benzaldehyde U.S.P., tech., drums	lb.	.70 – .72
Benzene, pure, tanks, works.	gal.	.25 – .....
Benzene, 90%, tanks, works.	gal.	.23 – .....
Benzidine base, bbl.	lb.	.80 – .81
Benzyl chloride, ref. carboys.	lb.	.35 – .....
Benzyl chloride, tech., drums.	lb.	.25 – .....
Beta-naphthol, tech., bbl.	lb.	.24 – .25
Beta-naphthylamine, tech.	lb.	.65 – .70
Cresylic acid, 97%, drums	gal.	.62 – .64
95-97%, drums, works	gal.	.58 – .60
Dichlorbenzene, drums	lb.	.07 – .08
Dinitrobenzene, bbl.	lb.	.15 – .17
Dinitrochlorbenzene, bbl.	lb.	.20 – .21
Dinitrophenol, bbl.	lb.	.35 – .40
Dinitrotoluen, bbl.	lb.	.18 – .20
Dip oil, 25%, drums	gal.	.26 – .28
H-acid, bbl.	lb.	.72 – .75
Meta-phenylenediamine, bbl.	lb.	.90 – .95
Monochlorbenzene, drums	lb.	.08 – .10
Naphthalene, flake, bbl.	lb.	.04¾ – .05¼
Naphthionate of soda, bbl.	lb.	.60 – .65
Naphthionic acid, crude, bbl.	lb.	.60 – .62½
Nitrobenzene, drums	lb.	.09 – .09
Nitro-naphthalene, bbl.	lb.	.25 – .27
Nitro-toluene, drums	lb.	.13½ – .14
N-W acid, bbl	lb.	1.00 – 1.05
Ortho-amidophenol, kegs	lb.	2.40 – 2.50
Ortho-dichlorbenzene, drums	lb.	.10 – .11
Ortho-toluidine, bbl.	lb.	.15 – .16
Para-aminophenol, base, kegs	lb.	1.15 – 1.20
Para-dichlorbenzene, bbl.	lb.	.17 – .20
Para-nitraniline, bbl	lb.	.68 – .70
Para-nitrotoluene, bbl.	lb.	.50 – .55
Para-phenylendiamine, bbl.	lb.	1.30 – 1.35
Para-toluidine, bbl.	lb.	.75 – .80
Phenol, U.S.P., dr.	lb.	.24 – .26
Picric acid, bbl.	lb.	.20 – .22
Pitch, tanks, works	ton	27.00 – 30.00
Pyridine, imp., drums	gal.	4.15 – 4.25
Resorcinol, tech., kegs	lb.	1.30 – 1.40
Resorcinol, pure, kegs	lb.	2.00 – 2.25
R-salt, bbl.	lb.	.50 – .55
Salicylic acid, tech., bbl.	lb.	.32 – .33
Salicylic acid, U.S.P., bbl.	lb.	.35 – .....
Solvent naphtha, water-white, tanks	gal.	.24 – .25
Crude, tanks	gal.	.21 – .22
Sulphanilic acid, crude, bbl.	lb.	.16 – .18
Tolidine, bbl.	lb.	1.00 – 1.05
Toluidine, mixed, kegs	lb.	.30 – .35
Toluene, tank cars, works	gal.	.26 – .....
Toluene, drums, works	gal.	.31 – .....
Xylidine, drums	lb.	.40 – .42
Xylene, 5 deg.-tanks	gal.	.38 – .40
Xylene, com., tanks	gal.	.25 – .27

Naval Stores

Rosin B-D, bbl.	280 lb.	$7.50 – $7.60
Rosin E-I, bbl.	280 lb.	7.50 – 7.60
Rosin K-N, bbl.	280 lb.	7.60 – 7.70
Rosin W.G.-W.W., bbl.	280 lb.	8.30 – 8.80
Turpentine, spirits of, bbl.	gal.	.87 – .88
Wood, steam dist., bbl.	gal.	.80 – .82
Wood, dest. dist., bbl.	gal.	.65 – .68
Pine tar pitch, bbl.	200 lb.	5.50 – .....
Tar, kiln burned, bbl.	500 lb.	11.50 – 12.00
Rosin oil, first run, bbl.	gal.	.45 – .....
Pine tar oil, com'l.	gal.	.30 – .....

Animal Oils and Fats

Degras, bbl.	lb.	$0.03½ – $0.05½
Grease, yellow, loose	lb.	.08½ – .08¾
Lard oil, Extra No. 1, bbl.	gal.	.86 – .88
Lard compound, bbl.	lb.	.13½ – .13¾
Neatsfootoil, 20 deg. bbl.	gal.	1.35 – .....
Oleo Stearine	...	.13 – .13½
Oleo oil, No. 1, bbl.	lb.	.22 – .22½
Red oil, distilled, d.p. bbl.	lb.	.10½ – .10¾
Tallow, extra, loose works	lb.	.09¾ – .....
Tallow oil, acidless, bbl.	gal.	.86 – .87

Vegetable Oils

Castor oil, No. 3, bbl.	lb.	$0.17 – $0.17½
Castor oil, No. 1, bbl.	lb.	.17½ – .17¾
Chinawood oil, bbl.	lb.	.15½ – .....
Coconut oil, Ceylon, bbl.	lb.	.11 – .....
Ceylon, tanks, N. Y.	lb.	.10½ – .....
Corn oil, crude, bbl.	lb.	.11½ – .11¾
Crude, tanks, (f.o.b. mill)	lb.	.09¾ – .10
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.08¾ – .09
Summer yellow, bbl.	lb.	.11 – .11¼
Linseed oil, raw, car lots, bbl.	gal.	1.00 – 1.01
Raw, tank cars (dom.)	gal.	.94 – .95
Boiled, cars, bbl. (dom.)	gal.	1.02 – 1.03
Olive oil, denatured, bbl.	gal.	1.18 – 1.22
Sulphur, (foots) bbl.	lb.	.09½ – .....
Palm, Lagos, casks	lb.	.09½ – .09¾
Niger, casks	lb.	.08¾ – .08¾
Palm kernel, bbl.	lb.	.10½ – .....
Peanut oil, crude, tanks (mill)	lb.	.12½ – .....
Refined, bbl.	lb.	.16 – .16½
Perilla, bbl.	lb.	.14 – .14½
Rapeseed oil, refined, bbl.	gal.	.97 – .98
Sesame, bbl.	lb.	.13 – .13½
Soya bean (Manchurian), bbl	lb.	.12 – .12½
Tank, f.o.b. Pacific Coast	lb.	.11 – .11½

Fish Oils

Cod, Newfoundland, bbl.	gal.	$0.62 – $0.65
Menhaden, light pressed, bbl.	gal.	.68 – .70
White bleached, bbl.	gal.	.70 – .71
Crude, tanks (f.o.b. factory)	gal.	.55 – .....
Whale No. 1 crude, tanks, coast	lb.	..... – .....
Winter, natural, bbl.	gal.	.75 – .76
Winter, bleached, bbl.	gal.	.78 – .79

Dye & Tanning Materials

Albumen, blood, bbl.	lb.	$0.50 – $0.55
Albumen, egg, tech, kegs	lb.	.95 – .97
Cochineal, bags	lb.	.33 – .35
Cutch, Borneo, bales	lb.	.04½ – .04¾
Rangoon, bales	lb.	.13½ – .14½
Dextrine, corn, bags 100	lb.	4.52 – 4.79
Gum, bags 100	lb.	4.82 – 5.09
Divi-divi, bags	ton	42.00 – 43.00
Fustic, sticks	ton	30.00 – 35.00
Chips, bags	lb.	.04 – .05
Gambier com., bags	lb.	16½ – .16¾
Logwood, sticks	ton	25.00 – 26.00
Chips, bags	lb.	.02½ – .03
Sumac, leaves, Sicily, bags	ton	160.00 – 165.00
Domestic, bags	ton	50.00 – 55.00
Starch, corn, bags 100	lb.	3.87 – 4.14

Extracts

Archil, conc., bbl.	lb.	$0.16 – $0.19
Chestnut, 25% tannin, tanks.	lb.	.01½ – .02½
Divi-divi, 25% tannin, bbl.	lb.	.05 – .05
Fustic, liquid, 42°, bbl.	lb.	.08 – .09½
Gambier, liq., 25% tannin, bbl.	lb.	.11 – .11
Hematine crys., bbl.	lb.	.14 – .18
Hemlock, 25% tannin, bbl.	lb.	.03½ – .04
Hypernic, liquid, 51°, bbl.	lb.	.12 – .13
Logwood, crys., bbl.	lb.	.14 – .15
Liq., 51°, bbl.	lb.	.07½ – .08½
Osage Orange, 51°, liquid, bbl.	lb.	.07 – .08
Quebracho, solid, 65% tannin, bbl.	lb.	.04½ – .04¾
Sumac, dom., 51°, bbl.	lb.	.06½ – .06¾

Dry Colors

Blacks–Carbongas, bags, f.o.b. works, contract	lb.	$0.09 – $0.11
spot, cases	lb.	.12 – .16
Lampblack, bbl.	lb.	.12 – .40
Mineral, bulk	ton	35.00 – 45.00
Blues–Prussian, bbl.	lb.	.36 – .37
Ultramarine, bbl.	lb.	.07 – .35
Browns, Sienna, Ital., bbl.	lb.	.05 – .12
Sienna, Domestic, bbl.	lb.	.03 – .03½
Umber, Turkey, bbl.	lb.	.04 – .04½
Greens-Chrome, C.P.Light, bbl.	lb.	.28 – .30
Chrome, commercial, bbl.	lb.	.10½ – .11½
Paris, bulk	lb.	.24 – .26
Reds, Carmine No. 40, tins	lb.	4.25 – 4.50
Iron oxide red, casks	lb.	.08 – .12
Para toner, kegs	lb.	.95 – 1.00
Vermilion, English, bbl.	lb.	1.30 – 1.35
Yellow, Chrome, C.P. bbls	lb.	.17 – .17½
Ocher, French, casks	lb.	.02 – .03

Waxes

Beeswax, crude, Afr. bg.	lb.	$0.28 – $0.28½
Refined, light, bags	lb.	.33 – .34
Candellila, bags	lb.	.26 – .27
Carnauba, No. 1, bags	lb.	.35 – .37
No. 2, North Country, bags	lb.	.27 – .28
No. 3, North Country, bags	lb.	.24 – .25
Japan, cases	lb.	$0.16 – $0.17
Montan, crude, bags	lb.	.06 – .06½
Paraffine, crude, match, 105-110 m.p., bbl.	lb.	.06½ – .06¾
Crude, scale 124-126 m.p. bags		.05½ – .....
Ref., 118-120 m.p. bags	lb.	.05½ – .05¾
Ref., 123-125 m.p., bags	lb.	.05¾ – .06
Stearic acid, sgle. pressed, bags	lb.	.11 – .11½
Double pressed, bags	lb.	.11½ – .12

Fertilizers

Acid phosphate, 16%, wks.	ton	$7.50 – $7.75
Ammonium sulphate, bulk f.o.b. works 100	lb.	2.70 – 2.75
Blood, dried, bulk	unit	3.85 – 3.95
Bone, raw, 3 and 50, ground.	ton	26.00 – 28.00
Fish scrap, dom., dried, wks.	unit	4.75 – .....
Nitrate of soda, bags 100	lb.	2.40 – .....
Tankage, high grade, f.o.b. Chicago	unit	3.00 – 3.25
Phosphate rock, f.o.b. mines Florida pebble, 68-72%	ton	3.00 – 3.50
Tennessee, 75%	ton	6.50 – 6.75
Potassium muriate, 80%, bags	ton	34.55 – .....
Sulphate, bags, 90%	ton	45.85 – .....
Double manure salt, bgs.	ton	26.35 – .....
Kainit, 14%, bgs	ton	10.25 – .....

Crude Rubber

Para—Upriver fine	lb.	$0.32½ – 0.32¾
Upriver coarse	lb.	.22½ – .22¾
Plantation—First latex crepe	lb.	.32½ – .32¾
Ribbed smoked sheets	lb.	.32½ – .32¾

Gums

Copal, Congo, amber, bags	lb.	$0.08 – $0.10
East Indian, bold, bags	lb.	.13 – .14
Manila, amber, bags	lb.	.14 – .16
Damar, Batavia, cases	lb.	.24½ – .25
Singapore, No. 1, cases	lb.	.27 – .28
Singapore, No. 2, cases	lb.	.18 – .18½
Kauri, No. 1, cases	lb.	.58 – .64
Ordinary chips, cases	lb.	.21 – .22
Manjak, Barbados, bags	lb.	.06 – .09

Shellac

Shellac, orange fine, bags	lb.	$0.67 – $0.68
Orange superfine, bags	lb.	.69 – .70
Bleached, bonedry	lb.	.73 – .75
T. N., bags	lb.	.65 – .66

Miscellaneous Materials

Asbestos, crude No. 1 f.o.b., Quebec	sh. ton	$300.00 – $350.00
Shingle, f.o.b., Quebec	sh. ton	50.00 – 60.00
Cement, f.o.b., Quebec	sh. ton	15.00 – 20.00
Barytes, grd., white, f.o.b. mills, bbl.	net ton	17.00 – 17.50
Grd., off-color, f.o.b., Balt	net ton	13.00 – 14.00
Floated, f.o.b., St. Louis, bbl.	net ton	23.00 – 24.00
Crude f.o.b. mines, bulk	net ton	8.00 – 9.00
Casein, bbl., tech.	lb	.10½ – .12½
China clay (kaolin) crude, No. 1, f.o.b. Ga.	net ton	7.00 – 8.00
Powd., f.o.b. Ga.	net ton	14.00 – 20.00
Crude, f.o.b. Va.	net ton	6.00 – 8.00
Ground, f.o.b. Va.	net ton	13.00 – 19.00
Imp., powd.	net ton	45.00 – 50.00
Feldspar, No. 1 f.o.b. N.C.	long ton	6.50 – 7.25
No. 2 f.o.b. N.C.	long ton	4.50 – 5.00
No. 1 gr'd. N.C.	long ton	15.32 – 21.00
No. 1 Canadian, f.o.b., mill, powd.	long ton	20.00 – .....
Graphite, Ceylon, lump, first quality, bbl.	lb.	.05½ – .06
High grade amorphous crude	ton	15.00 – 35.00
Gum arabic, amber, sorts, bags	lb.	.12 – .12½
Tragacanth, sorts, bags	lb.	.50 – .55
No. 1, bags	lb.	1.20 – .....
Kieselguhr, f.o.b. Cal.	ton	40.00 – 42.00
F.o.b. N.Y.	ton	50.00 – 55.00
Magnesite, calcined	ton	32.00 – 35.00
Pumice stone, imp., casks	lb.	.03 – .40
Dom., lump, bbl.	lb.	.06 – .08
Dom., ground, bbl.	lb.	.03 – .05
Silica, glass sand, f.o.b. Ind.	ton	2.00 – 2.25
Sand blast, f.o.b. Ind.	ton	2.25 – 3.50
Amorphous, 200-mesh, f.o.b. Ill.	ton	20.00 – .....
Glass sand, f.o.b. Ill.	ton	2.00 – 2.50
Soapstone, coarse, f.o.b., Vt., bags	ton	7.50 – 8.00
Talc, 200 mesh, f.o.b., Vt., bags, extra	ton	10.50 – .....
200 mesh, f.o.b., Ga.	ton	9.50 – 10.00
325 mesh, f.o.b. New York, grade A	ton	14.75 – .....

Mineral Oils

Crude, at Wells

Pennsylvania	bbl.	$2.75 – $2.85
Corning	bbl.	1.50 – .....
Cabell	bbl.	1.45 – .....
Somerset	bbl.	1.55 – .....
Illinois	bbl.	1.37 – .....
Indiana	bbl.	1.38 – .....
Kansas and Okla. under 28 deg.	bbl.	.75 – .85
California, 35 deg. and up	bbl.	1.40 – .....

Gasoline, Etc.

Motor gasoline steel bbls.	gal.	$0.14 – .....
Naphtha, V. M. & P. deod, steel bbls.	gal.	.13 – .....
Kerosene, ref. tank wagon	gal.	.13 – .....
Bulk, W.W. delivered, N.Y.	gal.	.08½ – .....
Lubricating oils:		
Cylinder, Penn., filtered	gal.	.33 – $0.36
Bloomless, 30@31 grav.	gal.	.24 – .....
Paraffin, pale 885 vis.	gal.	.15½ – .16½
Spindle, 200, pale	gal.	.21 – .21½
Petrolatum, amber, bbls.	lb.	.04½ – .04¾
Paraffine wax (see waxes)		

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	1,000	$140–$145
Chrome brick, f.o.b. Eastern shipping points	ton	45–47
Chrome cement, 40-50% Cr_2O_3	ton	23–27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00
Fireclay brick, 1st. quality, 9-in. shapes, f.o.b. Ky. wks.	1,000	40–43
2nd. quality, 9-in. shapes, f.o.b. wks.	1,000	33–37
Magnesite brick, 9-in. straight (f.o.b. wks)	ton	65–68
9-in. arches, wedges and keys	ton	80–85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48–50
9-in. sizes, f.o.b., Birmingham.	1,000	48–50
F.o.b. Mt. Union, Pa.	1,000	35–38
Silicon carbide refract brick, 9-in.	1,000	1,180.00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls,	ton	$200.00 – .....
Ferrochromium, per lb. of Cr, 1-2% C.	lb.	.30 – .....
4-6% C	lb.	.12½ – .....
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	100.00 – .....
Spiegeleisen, 19-21% Mn.	gr. ton	33.00 – 35.00
Ferromolybdenum, 50-60% Mo, per lb. Mo	lb.	2.00 – 2.25
Ferrosilicon, 10-12%	gr. ton	39.50 – 43.50
50%	gr. ton	72.00 – 75.00
Ferrotungsten, 70-80% per lb. of W	lb.	.88 – .90
Ferro-uranium, 35-50%, of U, per lb. of U	lb.	4.50 – .....
Ferrovanadium, 30-40%, per lb. of V	lb.	3.25 – 3.75

Ores and Mineral Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	$5.50 – $8.75
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 – .....
C.i.f. Atlantic seaboard	ton	18.50 – 24.00
Coke, fdry., f.o.b. ovens	ton	4.00 – 4.50
Coke, furnace, f.o.b. ovens	ton	3.00 – 3.10
Fluorspar, gravel, f.o.b. mines, Illinois	ton	17.50 – 18.50
Ilmenite, 52% TiO_2 Va.	lb.	.01½ – .....
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.39 – .41
Manganese ore, chemical (MnO_2)	ton	75.00 – 80.00
Molybdenite 85% MoS_2, per lb. Mo S_2, N. Y.	lb.	.70 – .75
Monazite, per unit of ThO_2, c.i.f., Atl. seaport	lb.	.06 – .08
Pyrites, Span., fines, c.i.f. Atl. seaport	unit	.11½ – .12
Pyrites, Span., furnace size, c.i.f. Atl. seaport	unit	.12 – .....
Pyrites, dom. fines, f.o.b. mines, Ga.	unit	.12 – .....
Rutile, 94@96% TiO_2	lb.	.12 – .15
Tungsten ore, scheelite, 60% WO_3 and over	unit	9.00 – .....
Tungsten, wolframite, white, 60% WO_3	unit	8.75 – 9.00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	3.50 – 3.75
Uranium oxide, 96% per lb. U_3O_8	lb.	12.25 – 12.50
Vanadium pentoxide, 99%	lb.	12.50 – 14.00
Vanadium ore, per lb. V_2O_5	lb.	1.00 – 1.25
Zircon, 99%	lb.	.06 – .07

Non-Ferrous Metals

Copper, electrolytic	lb.	$0.13¼ – $0.13½
Aluminum, 98 to 99%	lb.	.27 – .28
Antimony, wholesale, Chinese and Japanese	lb.	.11½ – .11¾
Nickel, 99%	lb.	.29 – .30
Monel metal, shot and blocks	lb.	.32
Tin, 5-ton lots, Straits	lb.	.52¾
Lead, New York, spot	lb.	.0865
Zinc, spot, New York	lb.	.0685
Silver (commercial)	oz.	.70½
Cadmium	lb.	.55– .60
Bismuth (508 lb. lots.)	lb.	1.85 1.90
Cobalt	lb.	2.50–3.00
Magnesium, ingots, 99%	lb.	.90–95
Platinum, refined	oz.	118.00
Mercury 75	lb.	70.00
Tungsten powder	lb.	.95–1.00

Industrial Developments of the Week

New Construction and Machinery Requirements in the Process Industries

Some Opportunities This Week

Cannery .... Eden, Wis.
Chemical .... Atlanta, Ga.
Chemical .... Cleveland, Ohio
Cotton oil .... Greenville, Tex.
Glass .... St. Louis, Mo.
Grindstone .... South Boston, Mass.
Oil refinery .... Panhandle, Tex.
Oxygen .... Tulsa, Okla.
Paper .... Stockton, Calif.
Pottery .... Washington, Pa.
Rubber .... Ashtabula, Ohio
Rubber .... Defiance, Ohio
Varnishes and waxes .... Racine, Wis.

New England

Mass., Pepperell — The Nashua River Paper Co., awarded the contract for the construction of a new paper mill, to H. L. Shattuck, Inc., Manchester, N. H. Estimated cost $100,000.

Mass., South Boston—Lombard & Co., 236 A St. (manufacturers of grindstone), are in the market for miscellaneous machinery for new plant.

Middle Atlantic

N. J., Hutchinson's Mills, (Trenton P.O.) —W. & J. Sloane, 5th Ave. and 47th St., New York, plans the construction of a linoleum plant containing 850,000 ft. of floor space. Estimated cost $2,000,000. Considerable machinery will be required.

N. Y., Schuylerville—Iroquoise Paper Co., D. Summers, Pres., awarded the contract for a 2 story, 60 x 100 ft. addition to paper mill, to J. W. Hennessey, 126 White St., Saratoga. Estimated cost $35,000.

Pa., Clearfield—Clearfield Brick Mfg. Co., manufacturer of fire brick and other refractories, awarded the contract for the construction of 3 buildings, one 3 story, 44 x 50 ft., and 2 one story, 68 x 70 ft. and 36 x 36 ft., to Ashley Rishel, Brown Bldg., estimated cost $40,000.

Pa., Washington — Finley Clay Pottery Co., awarded the contract for the construction of a 1 and 4 story, 160 x 160 ft. factory, to The Austin Co., 16112 Euclid Ave., Cleveland, Ohio. Estimated cost $150,000.

South

Ga., Atlanta—Atlanta Chemical Co., 61½ North Forsyth St., T. S. Chastlan, Vice-pres., plans to rebuild mixing mill on North Ashby St., destroyed by fire. Loss is estimated at $30,000.

N. C., Navassa—Armour Fertilizer Works, Union Stock Yards, Chicago, Ill., has tentative plans under way for rebuilding the portion of its plant here, which was recently destroyed by fire, loss is estimated at $100,000 including machinery.

Middle West

O., Ashtabula—Aetna Rubber Co., C. J. Dunne, Gen. Mgr., is building an addition to their factory. Estimated cost $25,000.

O., Cleveland—Harshaw, Fuller Goodwin Co., 545 Hanna Bldg., awarded the contract for the construction of 2 chemical factories, 51 x 164 ft. and 28 x 46 ft., on Newburgh Ave., to Forest City Steel & Iron Co., 1500 West 110th St. Estimated cost $40,000.

This free weekly service is published in the interest of the buyer and the seller, to bring them together and get machinery moving. These leads are reported by our authorized correspondents who are instructed to verify every item. Requirements for new machinery for use in the process industries will be published here free of charge.

O., Columbus — Ohio State University, Board of Trustees, is in the market for one 600,000 lb. testing machine for testing the resistance of materials to be installed in the new Engineers Experiment Station.

O., Defiance—The Defiance Rubber Co., recently organized has purchased the property of the Central Rubber Reclaiming Co., which was recently damaged by fire, and plans improvements including a devulcanizing plant. The company will reclaim rubber from scraps. S. Roberts is president. and C. L. Kintner is manager.

O., Osborn—The Wabash Portland Cement Co., Ford Bldg., Detroit, Mich., is preparing plans for the construction of a cement plant, here.

Wis., Eden—Stephens Canning Co., O. Stephens, Elkhart Lake, will build a 3 story, 82 x 200 ft. cannery. Estimated cost $200,000. Private plans. Owner is in the market for canning and conveying machinery, etc.

Wis., Racine—S. C. Johnson & Sons, 1012 16th St., awarded the contract for a 2 story, 82 x 90 ft. addition to factory, to A. C. Kappel, 526 Wisconsin. Estimated cost $50,000. Owner is in the market for special machinery to manufacture varnishes and waxes, also laboratory equipment.

West of Mississippi

Mo., St. Louis — Mississippi Glass Co., 4070 North Main St., will build a 1 story, 60 x 342 ft. glass factory on North 1st St. Estimated cost $100,000.

Okla., Tulsa—Tulsa Oxygen Co., First National Bldg., awarded the contract for the construction of a 1 story, 54 x 175 ft. factory for manufacture of oxygen for use in acetylene torches, on Santa Fe Ave., to J. R. Burnside, 315 South Frankfort St. Estimated cost $12,500.

Tex., Greenville—Greenville Cotton Oil Co., plans to rebuild cotton oil mill, recently destroyed by fire. Estimated cost $300,000.

Tex., Panhandle—Big 4 Refinery, Long Beach, Calif., plans the construction of an oil refinery, here. Estimated cost $150,000.

Far West

Ariz., Phoenix—Riverside Portland Cement Co., Riverside, Calif., is having plans prepared for the construction of a cement plant, capacity 4,000 sacks per day. Estimated cost $4,000,000.

Calif., Los Angeles—The American Manganese Steel Co., 19th and State Sts., Chicago, Ill., is erecting a 2-ton electric steel furnace plant here, for the production of manganese-steel castings.

Calif., Stockton—National Paper Products Co., Church and Stockton Sts., awarded the contract for the construction of a 1 story addition to its paper plant on East Church St., to Davis-Heller-Pearce Co., Delta Bldg.

Canada

Ont., Long Sault Rapids—Abitibi Power & Paper Co., Ltd., is in the market for new paper machines to increase capacity of newsprint to 1,000 tons daily.

Ont., London — Rug Brick & Sand Co., Ltd., Manor Park, is in the market for cement mixers, cement rug brick equipment, also light steel rails for trackage. Estimated cost $40,000. W. H. Thornton, c/o owner, is engineer.

Reports Not Yet Verified

Ky., Louisville — Kentucky By-Products and Chemical Co., has acquired a 455 x 500 ft. site on Magnolia Ave., between 18th and 16th Sts., and is considering the construction of a new plant.

Tenn., Signal Mountain — The Signal Mountain Portland Cement Co., James Bldg., Chattanooga, has preliminary plans under way for the construction of a 3rd unit at its mill here, to increase the output to about 4,000 bbl. per day.

Wis., Milwaukee — The C. A. Krause Milling Co., awarded the contract for designing and equipping its new corn products plant at 33rd Ave. and Burnham St., to The Fraser Co., 667 East Water St., Milwaukee. Estimated cost $1,500,000. This plant will replace one recently destroyed by fire.

Ont., Smoky Falls—Kimberley Clark Co., Neenah, Wis., plans the construction of a 250 pulp mill here, also 32 miles of railway to the plant.

Incorporations

American Industrial Chemical Co., carbon and oxygen, $6,250,000; T. L. Croteau, Wilmington, Del.

Associated Pharmacists of Massachusetts, Inc., Salem, drugs and chemicals, $30,000; E. W. Hackett, M. J. McSweeney, G. E. Morse, J. B. Barrett and H. R. Tyler, all of Salem, Mass.

H. S. R. Chemical Products, Inc., Boston, chemicals and varnishes, $100,000; A. Hoche, and H. D. Schutte, Lynn, and J. F. Rebuck Winthrop.

Industrial Alcohol and Chemical Co., Philadelphia, Pa., $100,000 to $500,000.

Cheramy Ltd., c/o L. Guerin, 30 St. James St., Montreal, perfume, extracts, toilet waters, creams, soaps, etc.

The Consolidated Sugars Co., New Orleans, La., $284,000; J. Van Beary, Thibodaux. Pres., A. J. Crozat, 2513 Marengo St., New Orleans Secy. and Treas.

Eagle Rubber Co., Farwell, Tex., $100,000; C. E. McCallum, S. P. Buster, C. J. Glenn.

Metropolitan Cleansing Products Co., soaps, $150,000; E. R. Brause, E. Levinson, John T. McGovern, New York.

Territorial Udylite Corp., Ltd., Jamestown, N. Y., electrical and chemical, W. G. Ritzer, A. B. Manley, C. D. Swift.

Synthol Chemical Co., Coliseum Bldg., Richmond, Va., to manufacture flavoring extracts, etc., $50,000; J. H. Fentress, Pres.

Chrystal Sulphur Refining & Fertilizer Co., Wilmington, Del., salt, $1,000,000.